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SUPPLEMENTS TO THE BULLETIN OF THE HISTORY OF MEDICINE

Editor: HENRY E. SIGERIST

No. 2

The Religious and Philosophical Aspects of van Helmont's Science and Medicine

BY

WALTER PAGEL

BALTIMORE
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Price: $1.00

For subscribers to the Bulletin of the History of Medicine: $ .75

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PRINTED IN THE UNITED STATES OF AMERICA
BY J. H. FURST COMPANY, BALTIMORE, MARYLAND

Medical
Johns Hopkins Press
12-21-44

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INTRODUCTION *

Johannes Baptista van Helmont, a figure well known from all text books in the History of Medicine, Chemistry and Biology, is duly praised for his momentous discoveries.[1] He introduced the concept of "Gas," he was one of the first to use the balance in scientific, quantitative experiments. He devised one of the early thermometers. He taught the indestructibility of matter. He demonstrated acid to be responsible for digestion in the stomach and alkali for that in the duodenum. He is the founder of Biochemistry in that he studied and expressed vital phenomena in chemical terms. He proposed a reform of time measuring by use of the pendulum and devoted much work to the investigation of its laws. He is one of the founders of modern Pathology which he based on a study of the external agents and the anatomical changes in disease. His original anatomical, physiological and pathological research led him to a refutation of the "Folly of Catarrh," then the universal explanation of disease which was believed to be due to a flow of mucus from the brain straight through the base of the skull to all parts of the body, notably to the lungs and joints, causing pneumonia, consumption, rheumatism etc.[2]—As

* The author wishes to express his gratitude to Dr. V. C. Robinson, M. R. C. P., for kindly revising the manuscript and offering valuable suggestions.

[1] For the Chemical part of van Helmont's work I mention only: Metzger, H., *Les doctrines chimiques en France du début du XVIIe à la fin du XVIIIe siècle.* Paris, 1923, p. 165 ff. and Partington, J. R., Joan Baptist van Helmont, *Ann. of Science*, 1936, I, 359.—For the biological and medical part: Pagel, W., J. B. van Helmont, *Einführung in die philosophische Medizin des Barock.* Berlin, 1930; id., Van Helmont, Leibniz, Stahl, *Arch. Gesch. d. Mediz.* 1931, XXIV, 19; id., Van Helmont DE TEMPORE and the History of the biological concept of Time. With notes on the Greek concepts referred to in van Helmont, *De Tempore* by Helene Weiss. *Osiris.* In Press.

[2] The decisive part which van Helmont's work played in the abolition of the "Folly of Catarrh" has been fully described and documented by W. Pagel, *J. B. van Helmont.* Berlin, 1930 (with translation of van Helmont's treatises: "Catarrhi

a rule, it is mentioned that his treatises make dull reading as they are mixed with theosophical speculations, the account of dreams and visions. The usual method is to extricate from these the scientific detail which is valid today or should be regarded as stepping-stones of scientific discovery. The rest is " excused " with the spirit of the age. It was customary in his day to mingle matters scientific and philosophical. Then, the scientist, it is supposed, had to offer his new knowledge in a religious or philosophical cloak in order to be read or to be believed. In any case, van Helmont's Theology and Philosophy are not taken seriously. According to the usual accounts he must have lived in two worlds which are actually not reconcilable; there is the famous catchword of the " Two Souls in the same Body " and similar superficialities which serve to justify a summary dismissal of the " dark " chapters of his work.

While van Helmont's original discoveries and true scientific yearning are generally recognised among Historians of Medicine and Science, the position allocated to van Helmont in the History of Philosophy is still less adequate. Here hardly any knowledge or

Deliramenta," " Asthma et Tussis " and " Pleura Furens "). See also about Charleton's English translation of the Catarrh-treatise and van Helmont's merits in the refutation of the ancient Rheumatism-Theories: Riddell, Wm. Renwick, The Original Rheumatism. *Canad. J. Med. & Surg.* 1933, LXXIII, 128.

In spite of these, van Helmont's merits are still not sufficiently recognized. In a recent sketch of the History of Rheumatism, F. Klinge does not even mention van Helmont and gives full credit to Conr. Vict. Schneider who described the mucous membranes and confirmed the local origin of the Catarrh-Fluid therein, which was established before him by van Helmont. (Klinge, F., Der Rheumatismus. *Ergebn. Allg. Pathol. u. Pathol. Anat.* 1933, XXVII, 1).

Refutation of " Catarrh " in the old sense of a flow of fluid from the head to lower parts of the body is so self-evident to the present day observer that it is difficult to understand the long time interval which was needed until this concept was completely abandoned. The 1713-Edition of Castelli's *Lexicon Medicum Graeco-Latinum* says under " Catarrhus " (p. 146) that van Helmont in his " peculiar " treatise contended that the whole concept of " Catarrh " should be banned from the realm of Nature and medical consideration. " But this is not the place," the author continues, " to ventilate the jests of this importune reformer, although he has managed to find even to-day some followers." And this, after he has devoted one column to the various theories of " destillatio a cerebri intemperie frigida et humida et ab omnibus quae replent caput," or to a more qualified version, according to which each kind of flow from higher to lower parts in the body is understood as " Catarrh." This was printed about 70 years after the " Ortus Medicinae " and more than 50 years after C. V. Schneider's *De Catarrhis.*

understanding of his medical and scientific achievements is attempted—yet one disapproves of them. It is explained that van Helmont vigorously militated against the use of "Ratio," i. e. formal Logic and mathematical patterns. What can be expected from the scientific endeavour of a man with so strong an aversion against the elements of science and philosophy? [3]

[3] Nève de Mévergnies, P., *Jean Baptiste van Helmont, Philosophe par le Feu.* Bibliothèque de la Faculté de Philosophie et Lettres. Univers. de Liège. Fasc. LXIX, Paris. Droz. 1935.—

This book contains excellent bio- and bibliographical detail and promises to explain the deeper "philosophical" meaning of van Helmont's work which has not been recognized so far. The result is: van Helmont's "philosophy" is "Hermeticism," i. e. the belief in the transmutation of metals and a universal remedy such as "Aurum Potabile." The praise accorded to van Helmont as a worthy contemporary or predecessor of Descartes, Bacon, Boyle, Leibniz, Harvey, Glisson, Willis etc. is, therefore, not justified and the result of uncritical enthusiasm or local-patriotism.

Van Helmont's "hermetic" aspirations and belief are obvious to any student of his work. But it is hard to see how "Hermeticism" can be accepted as "Philosophy," i. e. metaphysics or epistemology. I agree with Nève de Mévergnies that it is necessary to trace the philosophical link which unites the parts of van Helmont's work to one whole and to study its significance in the History of Philosophy. To find this in "Hermeticism," however, is tantamount to deny any such significance. Why not follow up the metaphysical insight which van Helmont admittedly did possess (p. 149; 171), instead of dismissing it summarily in a footnote with the curious comment that "one swallow does not make summer"? A full account of van Helmont's real metaphysical and philosophical ideas and their comparison with those of "full time-Philosophers," notably of Leibniz, would have been the more correct and scientifically fair way.

Moreover, there is no proof that Alchemy was actually the basis of van Helmont's Cosmology, Metaphysics and Theology. The converse could be assumed with equal right and his "Hermeticism" derived from these. There is no need for "Hermeticism" as the explanation of what appears to the present day observer as "Bizarreries" and contradictions, in van Helmont's work. As soon as this is envisaged as an organic whole and not individual doctrines and discoveries are extricated from it, the "Bizarreries" disappear.

On the other hand there can be no honest interpretation and appreciation of van Helmont, unless his scientific, biological and medical contributions are thoroughly examined. His advanced Biology cannot possibly be dismissed with the remark that he did not understand the exigencies of matter and evolution, but simply transferred, to the realm of Life, his belief in the transmutation of metals which is all of a sudden brought about by the "Ferments." The example of "Spontaneous Generation" which Nève de Mévergnies gives in order to show that van Helmont was no "Biochemist" and indeed no Biologist at all, proves nothing. Aristotle, the first genuine Biologist, subscribed to the theory of Spontaneous Generation, a

Obviously no attempt at understanding van Helmont's work as a whole has been undertaken. We live in a period in which the clean separation of religion and science, of belief and knowledge, of vision and reason is felt to be the elementary premise of scientific activity, and so it does not occur to us that this was not always so and that the continuous affirmations of religious motives and purposes in van Helmont's scientific work might be more than figures of speech or symptoms of a morbid or archaic soul. In order to give a true

widespread belief in van Helmont's time which even Harvey's "Ex Ovo Omnia" did not refute.

Moreover, van Helmont himself has clearly separated spontaneous from normal generation. There is nothing in his concept of the latter which could justify a comparison with the transmutation of metals and the *sudden* action of ferments. On the contrary the process of normal generation is described as a very complicated series of events (Compare: van Helmont, Imago fermenti impraegnat massam semine 8 ff. for the separation of normal and spontaneous generation.—Process of generation: Archeus Faber 6 ff.).

Even if it could be proved that "Hermeticism" and the concept of transmutation are the basis of van Helmont's Biology, what would it matter? It would only show that the "dark" mysticism of the alchemical adepts, that "Magic," is the germ cell of advanced biological insight into the "specificity" of the living being and into the impossibility to demonstrate the "essence" of Life scientifically.

Even if van Helmont's knowledge and methods are to a large part Empiricism, this has more of a scientific "air" than the formal logic and humoralistic lore of the Schools. Nève de Mévergnies seems to regard the latter as "scientific." Van Helmont at any rate did not attack them because of their using "scientific" methods (in the modern sense) and because the "born" physician of his ideal would exclude or deprecate "Science." The opposite is the case. Van Helmont made systematic scientific and medical experiments, he combined their evaluation with the use of "Ratio" in the modern scientific sense and based all this on sound anatomical and physiological knowledge. In other words he was a true scientific worker. This is not the only attitude which he offers to the present day observer. But it is just as much *one* side of his personality as the attitude of the "Hermetic." The "scientific" Schools, however, he duly unmasked as unscientific, in that they followed methods inadequate for the study of Nature which to them was largely a battlefield of hairsplitting formal logic.

Nève de Mévergnies suspects van Helmont to have used religious and biblical language in the alchemical part of his work in order to avoid ecclesiastical persecution. This would mean that van Helmont was actually not as deeply religious as he appears to be. But why did he use the same religious language in almost each of his treatises, in those on Time, on the "Folly of Catarrh" etc. etc.?

It is easy to compile the "hermetic" passages from van Helmont's work and to demonstrate his adherence to the belief in Satan and witches. But to deny him, on account of this alone, the place which he duly deserves among the great early

historical picture of van Helmont as well as of the discovery of such fundamental scientific entities as "Gas" or "Ferment" or "Contagium," I think, it will be indispensable to investigate the inter-dependence and mutual motivation of van Helmont's religious-philosophical and scientific side.

I shall, therefore, follow a method directly opposed to the tendency to extricate scientific detail from the general philosophical or theological frame in which it is offered. It will emerge:

(a) that purely physico-chemical or physiological or medical entities to their discoverer meant notions of a wide cosmological and general-biological range which only a *religious* mind could adequately conceive, and

(b) that here is a classical example of the *active* role which religious motives, such as antagonism to "Ratio" played in the birth of modern Science during the seventeenth century.

scientists of the XVIIth century, is impossible unless the sum total of his truly scientific achievements is completely neglected. To van Helmont and most of his distinguished scientific contemporaries the "magic" virtues were just as much natural phenomena as "Gas" and "Ferments" and therefore objects of scientific research.

In any case, credulity and "Hermeticism" have in no way prevented van Helmont from making his momentous discoveries in Chemistry and Medicine and from indefatigable scientific work in the modern sense. I do not hesitate to believe that his religious conviction was a strong incentive for scientific work. Why should this diminish the significance of the latter? It is most bewildering to see some words of Bergson about the harmful influence of mysticism on science applied to van Helmont who was perhaps the only philosopher who closely approached and foreshadowed Bergson's concept of "Durée" in his "theo-biological" treatise *De Tempore*.

I

Van Helmont's Criticism of Methods and Substance of Heathen Natural Philosophy and of the "Schools"

A large proportion of van Helmont's work is polemical in character and chiefly directed against the Schoolmen who had based their learning on Aristotle's philosophy.

First of all it attacks their *methods*. At the Universities and Schools of van Helmont's time the study of Nature consisted of the academic discussion not of phenomena observed, but of their interpretation in terms of formal logic and of mathematical patterns which were uniformly applied to all fields of nature irrespective of the actual phenomena and their observation. It was sheer reasoning—Ratio—which pretended to make man omniscient by means of the art of discussion and combination. This kind of "Ratio," van Helmont says, will argue about questions such as: Why does light illuminate, why is water humid, why does it retreat from the immersed finger? The clearer a thing in itself, the more silly, remote and stupid the reason given for it. In this way of reasoning an immobile mover was introduced who should make motion and natural phenomena possible. A continuum of infinite indivisible points was supposed to be the underlying essence of Time; nebulous "Contraria" and "Similia," the universal action of heat, its combat with cold, the interaction of things humid and dry, sympathy and antipathy, the action of the stars served to explain processes in life and nature schematically. Phenomena had been subordinated to generally ruling principles such as that the "Generans" cannot be a part of the "Generatum" or that Nature is the initiation of motion in the moveable or that efficient causes must enter the object from outside—in short, science was a battlefield of formal logic and mathematical reasoning.[4] This is, in van Helmont's opinion, alien to Nature which deals with reality.

[4] On the significance of geometrical patterns in ancient thinking see Cornford, F. M., Greek Natural Philosophy and Modern Science in Needham, J. and Pagel, W., *Background to Modern Science*. Cambridge, 1938, p. 12: Geometry setting the pattern of all organised knowledge in antiquity, accounts for "the ancients defining the substance of things" whereas the moderns formulate sequences of events.

Truth is a real thing, reason an " Ens Rationis," a mere product of mental activity and therefore a Non-Ens. " Ratio et Veritas sunt disparata in radicibus." [5] Reason is by no means the highest function of the intellect, it is developed to a high degree of perfection in freaks of Nature, in the mentally deficient and in animals, notably foxes which outwit their enemies most skilfully.[6] Much more reliable than the logical conclusion is the knowledge of premises. In the end " ratio " is not more than the art of talking and arguing, given to man since the time of his fall, it is " defaecatissima " and a " worthless talker " (" garrula nequam "). It " dilutes, obscures, hampers, and smothers that noble activity of intellect by which knowledge is gained of the premises laid into us." [7] Van Helmont devoted a special treatise to the uselessness of the " Sermocinalia," entitled " Logica Inutilis." Most syllogisms are negations, science has to be positive, " cum sit positivi et de positivo." [8] Logic in no way adds to our knowledge, it does not provide any true " inventio," it but resumes something already known to the reasoning person, it is but arguing which serves to impress one's personal opinion on an audience by special adaptation and composition of words.[9] The same applies to mathematical patterns and considerations: It is not man who measures nature, but only nature itself.[10]

Formal Logic and Mathematics are particularly useless in the investigation of Life. We may disentangle individual phenomena or problems of Life and discuss them, but Life itself beats the human intellect. It is a sort of " light " descending from the " Father of Lights " and thereby outside the " Mundus intellegibilis," a term wrongly used by the Schoolmen for God who in no way " cadit sub intellectum nostrum." Like God himself, the " Powers of Life," its essence, direction and distribution are not accessible to our intellect. They are bestowed by God, distributed individually and situated in the non-intellectual, deeper layers of the soul. How little is motion and life itself affected by the blotting out of intellectual functions such as memory and speech! How easily is the weak intellect overcome by the morbid reactions of the Life-centre, such as syncope,

[5] Venatio Scient. 27.
[6] *Ibidem* 34.
[7] *Ibidem* 20 ff.
[8] Logica inutilis 11.
[9] Logica inutilis 23.
[10] Causae et initia natural. 41.

epilepsy, apoplexy, by life forces which emanate not from the brain, but from the actual seat of the soul, the mouth of the stomach! [11]

Van Helmont's refutation of formal logic and mathematical reasoning is the "negative" critical platform which he builds up for his original scientific methods and research and is largely actuated by *religious* motives. The domination of formal logic results from Hybris of the human mind which believes itself capable of mastering God's creation. It is the heathen Aristotelian doctrine, long ago refuted by St. Paul, but stubbornly followed by the Schoolmen.[12] Appropriate methods must be sought by which the creator and his intention in creating living beings—and that is reality—can be approached, as far as our "Docta Ignorantia" of matters divine and infinite will allow.

In van Helmont's age opposition to Aristotelian Philosophy and its application to the study of Nature was widespread. The "Novum Organum" sets out with the verdict: "Logica est inutilis ad inventionem scientiarum." Ramus, Taurellus, Telesio, and Campanella, Comenius, Stiernhielm [13] and others fight against Aristotle, against formal logic and for the "Propria Principia" in nature-studies, often achieving not more than a substitution of new syllogisms for the old ones. But the *religious motives* of the scepticism towards complacent human reason are nowhere as clearly expressed and illustrated as by van Helmont and his work.

His criticism does not stop at the *methods* employed by the Schoolmen. The *substance* of pagan philosophy so shamelessly adopted by the Christian Schools is still more the target of his fierce attacks.

The old Greek theory of the four elements, the four qualities and four humours was the chief pillar of seventeenth century natural philosophy. It was rejected by van Helmont—in the same way as he rejected the primitive attempts, by the "spagyric" school of the "Paracelsists," at substituting for the ancient four elements the three "principles": Sal, Sulphur and Mercury. Van Helmont endeavours

[11] Confirmatur morborum sedes in anima sensitiva 6.

[12] Venatio scient. 37; Logica inutilis 20.

[13] Compare Nordstroem, J., *Georg Stiernhielm Filosofiska Fragment med inledning och kommentar.* Stockholm, 1924. "Aristotelem, quem sectantur Ducem et Principem, hominem fuisse stultum et arrogantem; verbosum rixatorem, et contumeliosum derisorem." Vol. II, p. 93.

to show that all these elements and principles either do not exist or do not constitute matter, and that where they are, their function has been misunderstood. A few examples may be quoted: Bile which in ancient Physiology and Pathology assumes chiefly the role of a nocuous humour shortening life and initiating disease, is according to van Helmont's experimental and empirical knowledge a humour essential in digestion and life, a "Viscus nobile et vitale."[14] An "Innate Heat" and warmth in general are the essential life factors in ancient physiology, the agents which elicit and activate the development of seeds and govern the building up of the living structures and their function. Warmth is the factor responsible for digestion of food in the stomach.[15] Van Helmont's rejection of heat as the chief vital factor is the key note of his critical as well as his constructive work in science, biology and medicine. Heat is a *companion* of life, it is a "signum" of the modus operandi in warm blooded animals.[16] But it cannot be a requisite essential for life, since life is just as real in fishes and frogs as in the lion, in "cold" poppies just as in the "hot" pepper. It is not because our warmth cools off or because the mysterious "Humidum Radicale" in us is consumed that we die, but because we die, warmth disappears and humours dry up.[17] There is no heat innate in the heart or essential for the maintenance of the pulse. The heart of the frog expands and relaxes in the same way as that of any other animal, becoming pale in systole and darkening in diastole. The Schoolmen admit that the concept of "Heat and Fire in the Heart" is a metaphor—but Nature does not produce metaphors.[18]

In the jargon of the Schools warmth comes under the heading of "Accidentia," yet creative forces such as the production of "forms" and living entities as the developing chick have been ascribed to it.[19]

[14] Scholarum humoristarum passiva deceptio, Cap. II: Superfetatio supplementaria ad humorum fallaciam, 8 and 24.

[15] Aristotle, *De generatione animal.* II, 3 ed. Smith-Ross. Vol. V, Oxford, 1912, p. 736 b-737 a: "All have in their semen vital heat, which causes it to be productive; the heat of the sun and that of animals does generate them."

[16] Blas Humanum 15.

[17] *Vita,* ed. Amsterod. 1652, p. 585; ed. M. B. Valentini, Hafniae 1707, p. 691.

[18] Blas Humanum 16-19.

[19] Physica Aristotelis et Galeni ignara 7.

In van Helmont's opinion warmth may favour the production of "forms," it hastens the hatching of an egg, but it cannot generate anything but further heat. The axiom of the Schoolmen that any agent which predisposes to creation and development of a "Form" also produces that "Form," strikes van Helmont as not only wrong but also *atheistic*.[20] God alone creates the forms and substances. These differ from each other in principle as well as in their products; in other words they are *specific* in themselves and thereby completely different from heat which is a *general* medium and in no way specific.

The dominating role attributed by the Schoolmen to heat is but a symptom of their materialistic (and therefore atheistic) thinking. This recognises only *quantitative* and *locative* changes in the same everlasting and immutable matter as the causes of natural processes and phenomena. A "too much" (*τὰ ὑπερβάλλοντα*) or a "too little" (*τὰ ἐλλείποντα*), "Polarity," "Contraria" (*τὰ ἐναντία*), the combat between and the balance of cold and warm, dry and humid, attraction and repulsion of the uniform atoms and elements account for the course of nature, nay make changes possible. In van Helmont's opinion, the predominance of these heathen doctrines prevented the development of real science and truth and had a particularly devastating influence on Medicine. Therapy was directed against the fictitious humours, elements and qualities and thus led to indiscriminate bloodletting and purgation with the resulting decimation of mankind. If somebody pricks his finger with a thorn, neither bloodletting nor purgation will cure him, only the removal of the cause of the disease which comes from outside. Diseases differ from each other in the same way and as much as their external causes. But to antiquity there were no such things as diseases in the sense of individual varying in signs, changes and outlook with the nature of the causative agent and the particular organ involved. Not diseases, but disease was the physician's concern, i. e. impaired function of the individual whose particular constitution was liable to upset his humoral balance.[21]

[20] Formarum Ortus 12.

[21] Sigerist, H. E., *Antike Heilkunde*. Munich. Heimeran. 1927, 1 ff. and On Hippocrates, *Bullet. Instit. Hist. Med.*, J. Hopkins Univ. Baltimore, II, 1934, p. 190 ff.

All this was bound up with a resurrection of the ancient belief in the stars and their profound influence on man's life, body and fate. Van Helmont recognises the whole system of diagnostic and prognostic tables which were based on this belief as pseudo-scientific and attacks it fiercely. To him the stars are time signals, they "necessitate" in that they indicate regular movement in the Universe. But, van Helmont asks with Plotinus, how can variety in nature, how can specificity be ever explained by uniform motion and its laws? Motion by which Aristotle defined Nature, must take place *in* something which exists and it is this something which has to be investigated.[22] The stars not possessing any "Ratio Causarum," can do nothing, nor can a Christian with impunity attribute to them duties other than to act as time signals.[23]

The materialistic theories of the ancients had been embellished by a senseless symbolism in which Sympathy and Antipathy and above all the Analogy between Macrocosm and Microcosm played a predominant role.

Paracelsus who like van Helmont was actuated by religious motives and decidedly opposed to Greek Humoralism and Materialism, had based his natural philosophy on the analogies between macrocosm and microcosm. His tradition was taken up, in the seventeenth century by Robert Fludd and finally by the Romantic movement of the early nineteenth century. Both Fludd and the romantic philosophers were deeply influenced by religious belief.[24]

[22] Physica Aristot. et Galeni ignara 2/3.

[23] Formarum Ortus 14; and: Astra necessitant, non inclinant nec significant de vita, corpore vel fortunis nati, passim; and: *De Tempore* 33. van Helmont admits, however, that the "Blas" in man not follows, but imitates the motion of the stars. Each viscus forms its own "Blas" "ad typum sui astri." Hence the Blas is called "Astrale." This explains periodical changes in the body, healthy and sick. Blas Humanum 5.

By "Blas" van Helmont understands an impulse originating in the stars which is responsible for air movements, winds, inundations, storms, etc. ("Blas Motivum"). It also distributes warmth and cold ("Blas alterativum") and accounts for changes in weather. By "Blas in Man" all dynamic impulses are understood, especially distance action from one organ on the other, such as the effects of hormons—"Actio Regiminis." Van Helmont studied these actions carefully in diseases and described masterly neuroses of the vegetative system including hysteria and asthma. See Pagel, J. B. van Helmont, *loc. cit.* 1930, pp. 67 ff.

[24] On the Macrocosm-Microcosm symbolism in Paracelsus, Fludd and the

Van Helmont himself is fond of symbolical language. He recognises the role of the celestial bodies in initiating motion by means of the emanation of " Blas," he admits certain influences on man, e. g. those of the moon on emotions, on somnambulism;[25] he believes in the forces hidden in herbs, words and stones.[26] He nevertheless unceasingly deprecates the concept of the analogies between Macrocosm and Microcosm and indefatigably fights against the assumption of " Contraria " and " Similia " in nature.[27] Why? His antagonism against these theories is deeply bound up with that against ancient materialism and like this actuated by *religious* motives. If everything with us is governed by forces identical with those which act in the outer world, if the processes observed in living beings here are but replicae of what occurs anywhere in the great world and particularly in the celestial bodies, then no place remains for *specificity* in Nature. Specificity, however, is vouchsafed by divine creation which occurs but once bestowing on every being the features essential for its *individual* life. " Philosophies of Identity " which resort to one or two forces acting everywhere in nature in the same way must of necessity dispense with the specific forms, functions and purposes which van Helmont attributed to the living being and to life at large. To him life meant a modification of matter which the creator compels to act in certain ways which are different in each individual being. Van Helmont, therefore, reserved for things vital the " private " right and privilege of specificity as opposed to the general—" public "—institutions such as the forces of the stars, attraction and repulsion, sympathy and antipathy, heat and cold, wind and air of which all beings in nature partake.

The belief in the unique natural force accounting for all phenomena in nature is in no way necessarily atheistic or alien to religious think-

Romantic School and their biological theories see: Pagel, W., Religious Motives in the Medical Biology of the XVIIth century. *Bullet. Instit. Hist. Med.* 1935, III, 97-312.—Strunz, F., *Theophrastus Paracelsus; Idee und Problem seiner Weltanschauung.* 2nd Edit. Salzburg-Leipzig, 1937, p. 111 ff.

[25] Formarum Ortus 52 ff.

[26] *In Verbis, Herbis et Lapidibus est Magna Virtus.* Ed. 1652, p. 458. Ed. Valentini 1707, p. 544.

[27] *Natura Contrariorum Nescia.* Ed. 1652, p. 126; Ed. Valentini 1707, p. 155. On the other hand compare van Helmont's qualified recognition of " Sympathy " in *De Magnetica Vulnerum Curatione* 1 ff.

ing, and the explanations given by the romantic philosophers of the nineteenth century cannot even be called " mechanistic," since their symbolical and philosophical meaning is obvious. Fludd, however, embarked on a hardly concealed mechanistic view of Nature, inanimate and vital. He constructs crude mechanical patterns for every process and phenomenon including diseases and endeavours to reproduce all phenomena of life by means of a universal model, a mixture of a primitive barometer and thermometer.[28]

Van Helmont's vitalistic point of view leads him to reject these *monistic* concepts. He equally deprecates *dualistic* theories which create a gap between body and soul, thought and extension. He himself builds up vitalistic *Pluralism*. This sees the world composed of innumerable *" seeds "* which are neither spirit nor matter but have something of both. Products of immediate divine creation, they are characteristic by their *life*, i. e. their *specific* form, function and development. They are not unlike Leibniz' *Monades*.

[28] See Pagel, Religious Motives, *loc. cit.* 1935, p. 272: Fludd's universal instrument and crude mechanistic view; p. 286: Fludd and Romantic " Naturphilosophie."

II

Van Helmont's Original Work

(1) *Methods:*
Illuminism, Docta Ignorantia, Empiricism, Pyrotechnia

This brings us to van Helmont's original work, his *scientific* endeavour and achievement.

Van Helmont's method of thinking and inventing aims at not less than eternal truth which only divine illumination can give. He employs the highest faculties of which the human mind might be capable: The union with the object itself. "The intellect transforms itself, by migration, into the recognised object." [29] When, in this state of mind, divine illumination is acquired, all mental faculties melt into one "mere intellect," and the light of divine grace spreads over the soul. Then the intellect penetrates to the kernel of the objects, to the "Ipsa Rerum Essentia." There is no room for imagination which stops at the outer appearance of the objects.

The intellectual union with the object is the "Ecstasis" which makes "miracles" possible.[30] It is the "Binshikah" of the Rabbis, i. e. the state "In the Kiss" which they say is dangerous and identical with "peaceful death" such as that of Moses, but which in van Helmont's opinion is not dangerous and the most desirable state of mind. In this state we may be able to see persons who are far away, when a certain ecstatic power is excited in our blood by an irresistable desire concentrated on this particular person. Somewhat similar is the condition induced by certain poisons such as wolfsbane, although both originate in the seat of the vegetative soul, the mouth of the stomach, and not in the brain.[31] It is a sort of intuition which van Helmont has in mind. It operates without the eyes and without the recollection of things seen before, a vision in which will, love and desire take part.[32] Van Helmont describes some such visions which he had himself. After 23 years of vain desire to visualise his own soul, he succeeded at last in 1633. His soul appeared as a

[29] Venatio Scientiarum 48.
[30] De Magnetica Vulnerum Curatione 74 ff.
[31] Demens Idea 12 ff.
[32] Imago Mentis 34.

homogeneous light in a human shape, a " spiritual substance " with its own crystal-like " splendour." Van Helmont, then, knew that this apparition was identical with a small illuminated space which, in a visionary representation of his vocation to Chemistry, he had seen in the wall of his room 23 years before and which had shown him " something indescribable." [33]

The ultimate essence of Life, the " Lux formalis " might lend itself to ecstatic vision, otherwise it is beyond the reach of human investigation.[34] It is indescribable, since Life in itself is God.[35] It is the forming power of the " Seeds " hidden in the life principle (Archeus) of plants, animals and everything which multiplies by generation. It may thus be recognised by Ecstasis. It cannot be seen with our eyes. But God who taught Solomon and Adam the properties of creatures may open our internal eyes, the eyes of the soul which were given to St. Theresa, which man had lost with the Paradise.[36]

The intimate essence of life, inaccessible to scientific or rational discourse, may thus be contemplated.[37] Van Helmont's Docta Ignorantia, however, concerns only the Deity and what emanates from Him "' immediate et fontaliter." Not unlike Nicolaus Cusanus who introduced the notion of Docta Ignorantia in the same sense in which it was practised by van Helmont, the latter recommends and undertakes scientific research himself, on things accessible to human investigation, on concrete objects which are comparable and measurable.[38] Such research, however, must be empirical, based on observa-

[33] Imago Mentis 13.

[34] " Omnem arcet mortalium indagationem." Spiritus Vitae 19.

[35] " Cum vita in abstracto sit Deus ipse incomprehensibilis." Blas Humanum 23.

[36] Pharmacopolium ac Dispensatorium Modernum 14.

[37] " Vita ergo humana est lux formalis . . . neque enim vitae essentiam intimam aliter umquam describeret, qui vitas rerum formales etiam in ecstasi videret. Quia verba desunt et nomina, quibus haec dicantur, tanquam etymo a priori. Et licet Deus, alicui vitae essentiam in concreto ostendisset, suum tamen docendi honorem, nulli umquam tribuet creaturae." Blas Humanum 22/23.

[38] The advanced philosophical distinction which van Helmont makes between infinity and things finite and comparable, is noteworthy in the light of the attempts at minimising his merits in Philosophy (see before footnote 3). This distinction plays a special part in his treatise De Tempore where he refers to the " Finiti et infiniti nulla est proportio " (cap. 16). It may be asked whether van Helmont was influenced by the writings of Nicolaus Cusanus who stressed the distinction e. g. in his treatise De Visione Dei. The question is not unimportant, as one of van

tion and experiment, and not on syllogism and reasoning. The means by which scientific knowledge is acquired are: "Quaerere et pulsare," [39] i. e. testing of nature by experiment. There is no knowledge of biological phenomena ("Archaei alteritates") other than "per nudam observationem."[40] Not book learning, tradition and conjecture based on inveterated formulae and tables will teach us the properties of herbs and remedies. On the other hand, sound observation and solid knowledge are gifts of divine grace which only the God-fearing will obtain. Religious life may thus actively support scientific research.

In nature studies man cannot go beyond observation, since we cannot formulate how transformations actually occur, for example that of the venous into arterial blood by means of the "ferment" intrinsic to the heart. No a priori statements on nature are possible to us.[41]

Van Helmont's method of choice in research is "Pyrotechnia," the application of combustion and he calls himself with pride: "Per ignem Philosophus." The ignorance of experimental chemical methods notably of "Pyrotechnia" marred the attempts of the ancients and of the Schoolmen.[42]

Fire is closely related to Light. They are different degrees of the same created entity. As Light acts on matter uniting with it and vivifying it, so fire combines with matter, converts and finally destroys it. In living matter the "Gas spirituale" of the blood ("Archeus") is the vector of the life-light and its vital impulses.

Helmont's famous experiments (see later footnote 65) was anticipated although not performed by Cusanus. I do not believe that van Helmont has simply copied this experiment, nor can I see how concepts common to all writers on "Mystic Philosophy" from Plotinus, Dionysius Areopagita and Boethius onwards can serve as a proof of dependence or plagiarism (see on the question: Prescott, van Helmont on fermentation. *Arch. Gesch. Mathem. Natwiss. Technik*, 1929, XII, 70 who is with Ch. Singer inclined to accuse van Helmont of plagiarism; Pagel, W., Helmont, Leibniz, Stahl, *loc. cit.* 1930, p. 42 and Partington, *loc. cit.* 1936, p. 376 who think that the dependence is not proved). It should be added that van Helmont's concept of Time differs from that of Cusanus.

[39] Logica inutilis 24.

[40] Pharmacopol. et Dispensat. modern. 14.

[41] "Eo quod naturae ipsae a priori non sunt demonstrabiles." Aura vitalis, p. 578.

[42] Complexion. atque mistion. elemental. figment. 40.

In the same way fire converts matter first into " Gas," i. e. smoke. Fire was created for the necessities of human life, it is the " blacksmith of the arts," it accelerates the maturation of seeds, the separation of things, in a time which otherwise would exceed that of human life. It opens up the arcana hidden in nature, it drives out the non essential admixtures, it separates the pure from the impure, the precious from the base, the nocuous from the useful, the crude from the mature. " Let us therefore exalt the Father of Lights, the Creator of Light." [43]

(2) *Religious Motives.—Van Helmont and Paracelsus*

In van Helmont's time exponents of the religious approach to natural philosophy, notably R. Fludd, expressed in definite terms the idea that empirical research into Nature is tantamount to worship. God is seen as the chief Chemist with Nature as His Laboratory. He works " conveniente arte spagyrica." [44] This view is based on the conviction of absolute unity in the Cosmos, on a crude pantheistic creed to which van Helmont never subscribed. But he says that God formed man in his image. The Schoolmen when describing man wrongly have, therefore, failed in recognising God and themselves.[45]

There is, however, another strong religious incentive in van Helmont's scientific endeavour: *Religious Pragmatism.* It is the desire to help his fellow-creatures by detecting and opening up the divine resources in Nature, the hidden forces in herbs, metals and stones which God willingly reveals to the worthy. God has created Life, and for the sake of Life science should be promoted. In this light *Medicine* appears as the ultimate aim of Science, and Physics as the means for the conquest of disease. " Terminatur ergo Physica tota in usum vitae, inventionem causarum morbi et remediorum." For this ultimate and decisive object, so far, says van Helmont, " very little has been done, nothing known, a lot promised, still more neglected, expected for a long time and done in a wrong way." [46]

[43] Formarum Ortus 37 ff.—On the universal proficiency of the " Analysis by Fire " in early Chemistry compare: Faerber, Ed., Boyle, in Bugge's *Buch der grossen Chemiker* I, Berlin, 1929, p. 175, and Boyle's criticism p. 181.

[44] Pagel, W., Religious motives, 1935, *loc. cit.* p. 268 ff.

[45] Venatio scient. 36.

[46] *Promissa Authoris* I, 16 (ed. 1652, p. 9).

The invention of remedies requires knowledge of the forces in Nature, their mode of operation, application, preparation, distance action, varying with the special purposes and dependants of the individual organs. Only the Godfearing will eventually attain the art of prolonging life.[47]

Religious motives thus led van Helmont (a) to scepticism towards human reason and (b) to empiricism as the way to truth and reality. His religious attitude alone explains the so called contradictions in his methods, endeavours and achievements. We can now *understand* why the scientist who used the balance, who designed scientific instruments, who expressed his results so admirably in quantitative and chemical terms, who founded Biochemistry and Pathology on experimental knowledge,—why this man deprecated "Ratio," accepted magic effects and miracles as genuine natural phenomena and never completely concealed his ultimate doubts in the possibility of full human knowledge.

Van Helmont feels that his science is new and unheard of, a revolution against the recognised lore of the Schools of his time.[48] Moreover he is conscious of his advance on the doctrines of Paracelsus which admittedly stimulated his work and with which he agreed in their critical position against ancient natural philosophy and humorism. Van Helmont's harsh rejection of entities which, in his opinion,

[47] Praefatio to *De Tempore*, ed. 1652, p. 501.

[48] "Inaudita dum pando, anteriorum errores sicubi detexerim, id coactus egi, ne qui me sequentur, in salebras impingant et scopo veritatis orbentur." Ibidem;—For the sake of those who will come after him van Helmont has decided to start from anew and to detect the errors of his predecessors, notably of Aristotle who knew nothing of Nature as it really is, of Galen who is "totus excrementitius et ignarus" (Ius duumviratus 41), and of Paracelsus. Van Helmont is aware of the opposition which he and his methods will arouse from those who will blame him for intolerable boasting and severity in polemics, those who recognise nothing which has not been advanced by themselves and deride or fear all that is new. But progress must not be allowed to be suppressed for such reasons. When prepounding "Nova et Inaudita" van Helmont will not interpret the inventions of others nor quarrel with authorities, and he is conscious of himself as a new founder of medicine which, so far, has only been known by name. (Promissa Authoris II, 4/5). All this, however, is not his own merit. God who has made disease severer and more complicated than in the "good old times" when the medicine of our forebears sufficed, has implanted new knowledge of healing into the worthy. Hence van Helmont's vocation for Chemistry and Medicine.

are not really found in Nature, does not stop short of Paracelsus. Van Helmont's attitude towards him is, therefore, in no way "dishonest." There are many fundamental points in which van Helmont's work supersedes that of Paracelsus. The latter adhered to pantheistic symbolism, to the analogies between Macrocosm and Microcosm, to Sympathy and Antipathy. He introduced the three new *general* principles of Sal, Sulfur and Mercury, i. e. forces which act everywhere and in the same way. He was thus prevented from developing an advanced vitalistic view such as we find in van Helmont's work. Van Helmont's experiments are the recognised basis on which modern Chemistry developed, those of Paracelsus convey suggestions that he was in some way in advance of his time. Van Helmont actually discovered and differentiated gases, he demonstrated the decisive action of acid in the gastric juice, he established the principle of the indestructibility of matter—all this by legitimate scientific methods. Paracelsus outlined in symbolical language a "Chaos" which probably covered Gas-like substances. He emphasised the existence of special digestive properties in every organ of the body, but does not mention the action of acid in the stomach.[49]

[49] "Als ein exempel mit der speiss, die mag kein andere Hitz, Feur oder digestio in sein ultimam materiam bringen, als allein der Magen der Menschen, der hatt den Gewalt." (*Opus Paramirum* III, ed. Strunz, p. 186; Sudhoff, vol. IX, p. 134) ". . . es ist im Magen Mund ein andere digestion zu verstehen, wie im Mund" (*ibid., loc. cit.*, ed. Strunz, p. 188).

Van Helmont argues as follows (Calor efficienter non digerit sed tantum excitative 13 ff.): If, as the Schoolmen believe, warmth is the digestive factor, intensive hunger and strong and molesting digestion should be accompanied by excessive heat. This is not the case. How can the same factor, viz. heat, be responsible for the most different digestions which take place in animals as unrelated to each other as man, dog, horse, fish, water animal and bird, each having its own kind of blood and excrement? These can only derive from different *specific* ferments ("proprietatibus formalibus"). If really heat was the factor of digestion, this should be better and more efficient in fever. The opposite is the case. There is no trace of digestion when food is brought into contact with a warm surface. Instead of being digested it putrefies. In van Helmont's opinion Paracelsus subscribed to the theory of heat as digestive factor and was ignorant of the specific ferment in the stomach. That is why he admired that certain very hard objects and even bone in the stomach of a dog are quickly absorbed or converted into chylus. "He who had the aspiration for the Monarchate in Healing, failed, having called this faculty admirable, knowing nothing about it and being ignorant of the ferments." (20) As early as a young boy van Helmont had learned that the "ferment" responsible for digestion in the stomach is acid. When feeding sparrows he often let them get hold of his tongue

On the other hand, Paracelsus recognised the importance of specificity in Nature, he sought for the "Seeds" [50] just as van Helmont, and arrived in Pathology at an early differentiation of diseases according to their external—specific—causes.[51]

with their beak and then noticed an intense acidity in the throat of the bird. This, he knew, was the reason of their greediness and good digestion. Later he saw that some acid sulfurous substance had reduced his glove partly to fluid which confirmed his conviction that acid is the principle of digestion in the stomach. Acid stimulates appetite. But it is a special and not any acid which digests in the stomach. ("Acidum esurinum, stomachicum, specificum et humanum: ita quidem per singulas brutorum species, specifice distinctum, quod ipsis sit appropriatum.") The specificity of the acid in each species of animals accounts for the fact that certain animals rather die than eat certain food, e. g. mice, field-mice and pigs detest beans. In conclusion: Warmth acts in a uniform way, the specific vital ferments act according to the exigencies of the species and living being in question. The vital faculty of transforming food "vere atque formaliter" van Helmont has called "*Ferment*" ("Eamque fermentorum nomine designavi" 30).

[50] "Also kompt der grunt in unser wissen und erkantnus, dieweil alle ding ein samen haben und im samen alle ding geschlossen seind. und die natur ist der fabricator in die figur, so gibt sie die form, die das wesen an im selbs ist, und die form zeiget das wesen an." Philosophia sagax der grossen und kleinen welt. Cap. 7 ed. Sudhoff, vol. XII, p. 176.

[51] Partington (*loc. cit.* 1936, p. 363) says that "the recent attempts to prove the great dependence of van Helmont on Paracelsus have gone too far and are often too vaguely expressed." Nève de Mévergnies, on the other hand, emphasises this dependence and refers particularly to the account of it given by the present author in his book on van Helmont (*loc. cit.* 1930). Here a multitude of conclusive quotations from Paracelsus and van Helmont has been adduced, and their relationship proved in no vague terms (e. g. Pagel, p. 15, 18, 34 ff., 39, 44, 48, 74, 77, 79, 84, 93, 112). The great progress achieved by van Helmont especially in Chemistry was pointed out at the same time (p. 10, 63, 110) and the passage quoted by Partington in favour of the dependence of van Helmont on Paracelsus (p. 41 of Pagel's book) was intended to and does prove the opposite, i. e. differences between the opinions of Paracelsus and van Helmont.

It is quite obvious for any impartial student that Paracelsus was remote from the attitude, methods and outlook of the modern scientist, i. e. the investigator of causality in the modern sense. Van Helmont definitely followed the ideal of the modern scientist, with no little success. Nevertheless, van Helmont realised the paramount importance of entities which are not accessible to causal analysis, especially in Biology, and subscribed, true to Paracelsus' tradition, to "Wholism," "Thinking in Analogies" and Symbolism. Hence van Helmont's recognition of "Specificity," qualitative differences of Beings, the particularity of Life, hence his "Pluralism" and refutation of flat "Iatrochemistry" or "Iatromechanism." The combination of research into the causes, as far as possible at his time, with wholistic biological Philosophy secures his unique and superior position in the History of Biology and in that of XVIIth century science and medicine.—Para-

(3) *"Semina."—Body and Soul.—Gas.*

The whole of van Helmont's work can be conceived as the search for the "Semina," i. e. the active principles in beings which are responsible for their *specific* form and function, i. e. the difference between them. These are not due to changes in the composition of matter, as believed by the Ancients. There must be positive entities which are created by God and in a certain way immanent in matter. The speculation as to how the non-corporeal is connected with and acts upon matter is the very centre of van Helmont's research which led him to his momentous discoveries in Science and Medicine. Again, its *religious* motives are obvious: It is the search for the *divine* spark in created beings with which he is concerned.

Van Helmont cannot agree with those who assume a gap between things corporeal and spiritual. Of course, there is inert matter, i. e. water, on the one hand and there are the seeds which bestow speci-

celsus has clearly anticipated the futility of the ancient elements and humoralism. His new "Tria Prima" (Sal, Sulfur and Mercury) are rejected in turn, together with the ancient elements, both by van Helmont and Boyle on empirical-scientific grounds. Paracelsus described in general outline results of daily experience, common sense and sound generalisation rather than products of deliberately planned scientific investigations which proceed from detail to detail and are found in van Helmont's work. Both Paracelsus and van Helmont subscribe to a system and Philosophy of their own, but the latter uses the equipment of the experimentalist to prove it. One example is Paracelsus' and van Helmont's position in Pathology. Both realise that there are disease-entities which differ according to their external causes, van Helmont's research is devoted to the detection of the causes which will teach him the remedy, i. e. how to remove the cause. In Paracelsus' Philosophy of Healing the specific character and cause of the disease are bound up with the remedy which indicates at the same time the cause—obviously the homoeopathic concept. I refer to R. A. B. Oosterhuis, *Paracelsus en Hahnemann, een Renaissance der geneeskunst.* Leiden, 1937. In spite of that, the emphasis laid on the specificity of disease in causes and character emerges clearly from Paracelsus' work, and forms another important link which connects van Helmont with it. I give a few quotations: "Wie vil genera mineralium so vil auch apostematum" (*Drei chirurg. Buecher,* l. III, de morb. Gall., ed. Sudhoff, vol. X, p. 529).—"Ein natuerlicher, wahrhaftiger Arzt spricht: Das ist morbus terpentinus, das ist morbus sileris montani, das ist morbus helleborinus etc., und nicht das ist phlegma, das ist branchus, das ist rheuma . . . diese namen komen nicht aus dem grund der arznei . . ." (*Paragranum* ed. S. VIII, p. 75). Recognising the specific character of disease, van Helmont rejects the homoeopathic idea as well as the galenic healing by "Contraria." There are other points in which van Helmont definitely differs from Paracelsus, e. g. in his refutation of "crises" (see footnote 131).

ficity, i. e. life, function, variety and transmutation on the other. We do not know how the creating God works, but there is reason to assume that the " Semina " are not unlike odours, which, we know, have a profound effect on living beings. Or they may be like light or flame by which matter is illuminated. The " illumination " of matter is brought about by an " odour " which confers upon it a " disposition for transmutation." The " Odour " is also called " Ferment " or " Image " of the thing which is to be formed or " Notion of what has to be done." [52] This entity acts on matter i. e. water, as van Helmont says, referring mainly to the authority of the Pentateuch and to some original observations and experiments which seemed to demonstrate that things, particularly plants and fishes, consist of water.[53] Water as such, however, is inert. It cannot generate anything out of itself. It is a " Gas lying on water " (" Gas obsidens aquam ") which receives the semen of a metal whereby the water is impregnated, condensed and gradually converted into a fluid mineral.[54] An " Odour " is not dispersed unless there is an " odorabile " present which is the " gas " of an object.[55] By the presence of the gas matter acquires a special condition by which it loses its coarse corporality and so to speak, meets the odour-like ferment half way, thereby becoming suitable for its reception.[56] Matter for this purpose is loosened and assumes a state not unlike that of putrefying substances. This is greatly furthered by heat. Matter becomes thus an "Aura " and is called "Archeus " as soon as it contains the image of the being. In some objects the "Aura " is very fine, in others, e. g. plants, it may be inspissated and appear as a juice or, in metals, as a dense homogeneous matter. It is in some way fluid (" Fluxibilis ") and has a certain " aspiration " towards the principle of life (the "Anima vivens ").[57] First, however, it forms the lower-vegetative-soul which is responsible for the—species-specific—shape of the body, but does not confer life.[58] The acquisition of the latter is greatly supported by the yearning of the Aura to partake of the divine light. The "Aura anhelat," it attracts the divine light (" splendour ") by

[52] Imago fermenti impraegnat massam semine 12.
[53] Complexion. atque mistion. elemental. figmentum 12; *ibidem* 30.
[54] Magnum Oportet 39.
[55] Magnum Oportet 36.
[56] Magnum Oportet 25.
[57] Imago fermenti i. m. s. 8 ff.
[58] Formar. Ortus 82.

breathing and thereby " comes to the light promised to its seed, then rests in the lower-vegetative-soul, unable to ascend higher." [59]

Not only when an object is formed for the first time, but also later, " ferments " act on the transformed matter, thereby trying to seduce the " archeus " from its own life plan and purpose. These foreign " ferments " act on the " sapor " and " odour " innate in things, i. e. on the spiritual nucleus of matter.[60]

Matter after having acquired the " ferment " or a " seminal property " of this ferment, and only such " disposed " matter is called " Gas." [61] Each body in nature contains such Gas. It is a spirit which under normal conditions is " concrete " or " coagulated like a solid body " and thereby kept dormant and detained. The whole body, however, may become volatile when it has combined with an appropriate ferment. This is seen for example in fermenting grapes, left lying about with their skin damaged. If the skin is intact, however, and the ferment thus prevented from access, they simply dry up without liberation of their Gas.[62]

A characteristic entity containing Gas is the " Semen," the germinal cell of every being in Nature. It is a substance, i. e. a piece of *matter* which contains the "Archeus," the " Gas spirituale " in which is hidden the " Ferment." [63]

Van Helmont himself establishes his discovery of " Gas " where he discusses matter, i. e. water. As far as their material part is concerned fishes are but water and can be artificially transformed into it. All plants and all flesh consist of water; stone, rock and clay are transformed into alkali salt, which, by addition of fat becomes water such as is seen in soap, lapis lazuli, etc. In this connection van Helmont reports [64] one of the first quantitative physiological experiments which became duly famous: the demonstration of the fact that a willow tree after some years of growth has consumed nothing of the earth. Van Helmont concluded that the substance of the tree must

[59] Formar. Ortus 66.
[60] Complex. atque mistion. elemental. figment. 40/41; Magnum Oportet 25.
[61] Complex. a. mistion. element. figm. 34.
[62] *Ibid.* 14.
[63] Imago ferm. i. m. s. 12.
[64] Compl. a. mist. elem. figm. 12; *ibidem* 30.

be derived from the water which was added to the earth at regular intervals.[65]

Conversion of bodies into water takes place after they have lost their specific seminal property, i. e. when they cease to be the well characterised entity which they represented before. If they are not immediately changed into water and forced to give up their fixed condition, for example by heating, Gas develops. In other words, Gas is a thing which has lost its concrete shape, but has not lost specificity. It has, therefore, actually lost nothing. It does exist and will never be consumed—as can be seen when charcoal is heated in a closed vessel; it may be heated until doomsday, yet will never substantially disappear. But it will be almost completely changed into a "wild spirit" (Spiritus sylvester"). It is "wild" because it cannot be held in an open vessel and it cannot be solidified unless it loses its "semen," i. e. specificity.[66] Finally it becomes water when by the action of cold at very high altitudes and after a long time interval it loses specificity and seminal properties. The extreme cold at the high altitudes of the sky also converts water into Gas (Gas aquae) by disintegrating its material composition, its solid (Sal), volatile (Sulfur) and fluid (Mercury) particles.

Gas is therefore, matter in a special form, it is "as far as matter is concerned from the element water."[67] But it is by no means matter alone. Matter in order to be Gas must retain specificity. Van Helmont clearly recognised—and here lies the main achievement of his chemical work—that Gas is, unlike air and watery vapour, no volatile medium common to *all* things, but something *specific*. It is the material vector of specificity which he believed he had discovered and demonstrated in every being in Nature. The Gas demonstrates empirically that particular alteration which matter undergoes when subjected to the action of a "Ferment." It shows that a deep substantial transmutation of matter follows and not only a different arrangement of the material particles without alteration of matter itself. The far reaching significance of "Gas" emerges from its role in living beings. We have seen that van Helmont attributed to it

[65] See before footnote 38 about the influence of Nicol. Cusanus.
[66] Compl. a. mistion. elem. figm. 14.
[67] *Ibid.* 28.

" seminalis proprietas " which it must lose in order to be converted into its original state: water. Since " Gas " contains the " concretum semen " it is capable of generation.[68] But above all the " Life-Spirit " in our arterial blood is Gas.[69] When it flees from the outer parts of the body they lose the appearance of living parts, such as seen in fainting, palpitation, syncope. The Archeus itself *is* Gas of the nature of a " balsamic salt," it can easily evaporate through pores, " munium agendorum atque familiae oblitus." Gas is therefore, not only the vector of specificity, but also that of " Life " in the widest sense.

It is thus that van Helmont feels the great progress which is due to his work—not so much because of the import of his discovery for Chemistry, but for the solution which he offered and empirically proved of the perennial problem of the action of the " spirit " upon matter. In van Helmont's concept the *immanence* of the dynamic principle in matter is emphasised—as opposed to its external and accidental action on it. Van Helmont achieved this immanence by spiritualisation and pneumatisation of matter. The great advance due to his work lies in the *empirical justification* of this tendency by the discovery of Gas. Gas was reality and truth, the elements and humours of the Ancients were fictitious. Gas was an empirical entity on which safely to base specificity in a vitalistic sense; whereas not more than a mechanistic pseudo-explanation was to be derived from the ancient concepts of imaginary changes in the arrangement of the material atoms. Gas showed how matter was enabled to unite with the divine spark of life, whereas the ancient theories did not require, nay rejected divine creation.

Van Helmont introduced a number of new entities which are represented in the diagram: By the action of the " forms " or " images " the divine light generates the dynamic principle in matter, the "Archeus." The "Archeus " forms out of matter the concrete objects in nature to which it confers specificity. The archeus is contained in the objects as "Aura," " Splendor," " Spiritus " or " Gas." All these represent organised matter. The Archeus in the " Semen " receives " Life " from God, with the help of the divine " fermentum " or " Odour." Developing material substance which

[68] Complex. a. mistion. element. figment. 34.
[69] *Ibid.* 40/41.

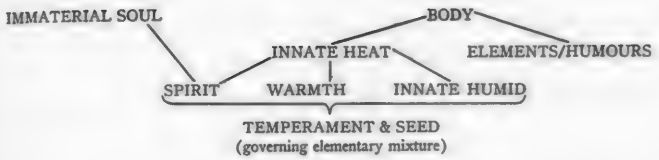

DIAGRAM ILLUSTRATING FERNEL'S CONCEPT OF MAN,
(for description see footnote 71)

as an example of the contemporaneous humoral and crude materialistic theory to which van Helmont objected and for which he substituted his new concept.

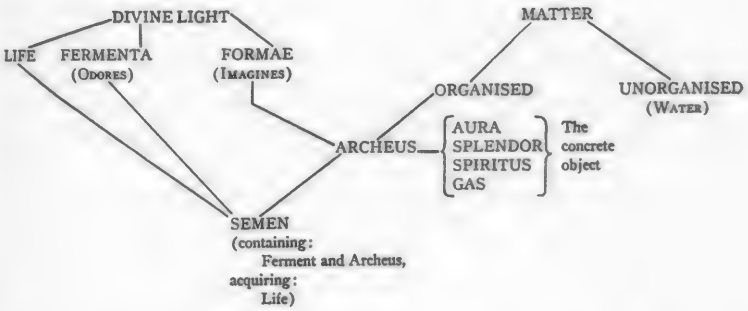

DIAGRAM ILLUSTRATING VAN HELMONT'S CONCEPT OF THE ORGANISATION OF MATTER

(a) contains the archeus with its aura, splendor or gas, i. e. "organised matter" and which is (b) endowed with the "Ferment" conveying Life is called "Semen."

(4) *Matter and its Immanent Biological Impulses. Biological Specificity*

Why was it necessary for van Helmont to represent the interaction of things corporeal and spiritual in such a complicated way? In the writer's opinion, van Helmont's chief motive was to do justice to his biological insight into the exigencies of living matter and the immanence of the dynamic impulses, chiefly those of generation in it. To make matter a lifeless, passive non-ens which obeys the command of the omnipotent soul, could not appeal to him as Biologist and Chemist. On the other hand, his religious conviction would not permit of a monistic view in which matter alone was responsible for life, particularly as it could not account for specificity. If, however, an empirical foundation could be established for the "spiritualisation" of matter, then the action of non-material "Ferments" on it would not interfere with its proper function. Moreover, "spiritualised," i. e. organised matter could easily act as the vector and guarantor of specificity. Finally, van Helmont's solution is the view of a stratification of well defined biological entities in the individual. This forms a unit with different aspects (a) the "material" organisation in the form of Aura, Gas or Archeus and (b) the "spiritual" plan of form and function.

Gas has therefore a meaning reaching much farther than that of a chemical entity. It embodies a notion of general philosophical and cosmological import; it is a genuine offspring of van Helmont's religious system of Nature.[70] It cannot be isolated from its cosmo-

[70] The religious and theological background of the problem of the origin and action of "spirits" in the blood could be illustrated by many examples, notably the well known fact that it was this problem and its discussion in a theological work ("Christianismi Restitutio") which provided the platform for the publication of Serveto's discovery of the lesser circulation.

The question of "what kinde of bodies shall those be after they be raised" was one of the practical catechism. In van Helmont's days H. Hammond, for example, described the "Spirituall Bodies" (I Cor. 15, 44) as follows:

"(1) In respect of the qualities *spiritualized* into a high *agility, rarity, clarity,* and such as will render them most commodious habitations for the soul, made par-

logical and religious background without endangering the full understanding of what van Helmont meant when he introduced and differentiated "Gas" as a new "Ens." Gas helps to build up the scientific representation of the mutual penetration of dynamic agents and matter. These are seen as a series with all transitions from finest corporeality—the odour of the "ferment"—to more and more coarse matter—Gas, and finally water. "Body" and "Soul" are different aspects of the same living whole, rather than entities inimical or subordinated to each other. Matter owes its shape and specificity of form to the same entity which is also responsible for its reception of life (i. e. function): to the Archeus or to the "Gas." This solved the problem of the "Qualitas Occulta" and Action of the "Tota Substantia" which hitherto was not accessible to scientific analysis, and had usually been explained by a "divine heat" in us (Fernel),[71] or by the action of the stars or by Sympathy

taker of that divine vision. (2) In respect of the principle of life and motion, which, in naturall bodies is some *naturall* principle, but in these is the *Spirit of God* which shall sustain them *without eating or drinking* etc."

It is thus that resurrection can be made *reasonable* to believe although we do not know how actually it will take place. (*A practicall Catechisme.* 5th edit. London, 1649, p. 302).

This shows the appeal which van Helmont's research on Gas must have had for wide circles of the clergy and indeed of the public, at a time when "Palingenesy" was a subject of discussion for the Royal Society. It is well known how the professors of "Palingenesy" such as Sir Kenelm Digby, Athanas. Kircher, Gaffarel, Schot and others believed that "Spirits" are a material product which is thrown off like a film or membrane from the surface of bodies. It is noteworthy that Lucretius to whom the concept of "Palingenesy" can be traced, assumed that the "soul" consists of "Perparva Semina" by means of which it is distributed all over the veins, viscera and nerves. It is thus comparable to the invisible and weightless "Succus et Odor Rerum" which consists of "Multa Minutaque Semina" (*De rerum natura* III, 214 ff.; ed. Creech, Oxonii, 1807, p. 160). The minute seeds, their distribution throughout the body as "Archei insiti," their "odor"-like quality and their condensation into a "succus," for example in plants—are concepts typical of van Helmont's "pneumatisation of matter" (see before and espec. Magnum Oportet 36, 39 ff.). On the whole, however, the differences between van Helmont's search for specificity in the "Semina," "Odores," "Spiritus" and the crude materialistic "generalising" concepts of Lucretius are obvious. On "Palingenesy" compare: Samuel Hibbert, *Sketches of the Philosophy of Apparitions.* 2nd edit. Edinburgh, 1825, p. 18 ff.; Smedley, E., Taylor, C., Thompson, H. and Rich, E., *The occult sciences.* London & Glasgow, 1855, p. 87 ff.

[71] *Universa Medicina.* Physiologia IV, 1 ff.: "Calorem quendam in nobis cunctisque viventibus inesse eumque divinum. . . . Animantium generi communi lege est

and Antipathy.[72] The union between Archeus (Gas) and Life (Ferment) is thus very close and made still closer by the introduction of the "Archei Insiti," i. e. the dynamic principles inherent in every organ, and indeed in the smallest particles of the tissues. Selecting from the stream of fluids the food suitable for the part in question and assimilating it into organ substance, the Archei Insiti act as metabolic centres. They convert the food which is offered to *all* organs into organ-*specific* material.

Thus, there is no room for Dualism. Stahl's system of "Animism" which is often regarded as the germ cell of genuine Vitalism, has separated matter and dynamic impulses ("Soul") by a wide cleft. Here the body is devoid of any right and action, it would continually decay but for the preserving power of the Soul. Life is preservation of matter from corruption. The Soul is not immanent

a natura tributum, ut insiti vi caloris vitam agant. . . . Spiritum quendam cunctis datum viventibus qui vitae calorem continet." Warmth must have a seat and vehicle in the body. The rapidity of its action and penetration excludes any fluid as seat and vehicle of the warmth. The very fine ether-like spirit seems to be the most suitable link between the "crassum corpus" and the "Animus." There are two groups of "spirits" in the body; The "spiritus stabiles et in unaquaque parte fixi," i. e. those which belong to the individual organs and tissues, and the three "errantes et vagi influentesque spiritus," offsprings of the three vital organs: liver, heart and brain (spiritus naturalis, vitalis and animalis).

The "Nature" of man, i. e. the first force and cause of our functioning and conservation, is the "innate heat" and consists of: (1) the prime humour, an oil-like fluid, (2) the spirit and (3) warmth. All these are contained in the "Seed." This "nature" of man is the "temperamentum" which is the result of the peculiar mixture of the elements and the perfusion of the divine warmth. (Physiologia, IV, 7.)

I have given Fernel's concept in detail in order to show the remarkable advance of van Helmont's scheme. It is obvious, however, that both have something in common, e. g. the differentiation of the spirit fixed to the organ and tissue—Archeus Insitus—and the general spirit—Archeus Influus—which in Fernel's opinion comes from liver, heart and brain, whereas van Helmont derives it from the stomach. There is also the tendency to introduce a link between coarse matter and immaterial soul, a link represented by matter of finest corporeality—the "spirit." But there is no emphasis laid on specificity, there is only the crude materialistic idea of mixture of elements with the "innate heat," accounting for the individual "temperamentum."

[72] A glance into the masterly collection of the theories of Elements and "Occult Virtues" given by Lynn Thorndike (*History of Magic and Experimental Science*, Vol. V/VI: XVIth century. New York, 1941, espec. Vol. V, p. 550 ff.) will reveal the differences and the progress achieved by van Helmont. It will also show where he stands on the shoulders of his predecessors. This particularly applies to Paracelsus (see Pagel, W., Religious Motives, 1936, *loc. cit.* p. 112 ff.).

in the body and its parts, it comes and directs it from outside. There is no cooperation on the part of the body. Motion, particularly obvious in circulation, is the universal instrument by means of which the Soul acts on the Body. Disease, disturbance of form and function, is an affair of the Soul alone, its main cause being: Emotions, abnormal circulation, Plethora etc. Material alteration of the body, anatomy, chemistry, morbid-anatomical and biochemical changes are of no interest; what matters alone is the mechanics of the movement of the blood and spirits, the influence exerted by the Anima. In building up his "Animism" Stahl might have been actuated by religious motives. He adhered to "Pietism," a special trend of Protestant thought in the early eighteenth century. Van Helmont, too used animistic notions and often identifies Archeus and Anima Sensitiva. The Anima is the Balsam which preserves the body not unlike the "Mummy" in Paracelsus' concepts.[73] The archeus directs and

[73] "Gas ergo vitale, quia lumen est atque balsamus, praeservans a corruptione ab primordiali geniturae adumbratione, incepit solari lumini adaequari." Complex. a. mistion. element. figment. 40/41. In this passage the function of the vegetative soul is directly attributed to the "Gas" in the blood, true to the old Hebrew tradition and to common contemporary opinion such as expressed for example by Harvey.

Similarly: "Est ergo spiritus vitalis, salinus ideoque balsamicus et custos a corruptione, idque non tantum ratione salis, quantum respecto luminis concepti in suo sale." Spiritus vitae 17. The venous blood produces when subjected to distillation a volatile "Spiritus salsus" which (unlike a similar substance from the urine) cures epilepsy even in the adult. This substance accounts for the conversion of venous blood into arterial "Spirit" in the heart, after the venous blood had been in contact with the air in the lung. It is this contact which allows the blood to become volatile without solid residuum ("Caput mortuum"). The air acts as "Aquarum Separator" by separating the watery vapour which is excreted, from the volatile spirit in the blood which is brought to the left heart and here converted into the "vital spirit." This vector of specific life forces and impulses is "Gas." Blas Humanum 45 ff.

One might interpret in the sense of Stahl's Animism, van Helmont's opposition to the sentence which he attributes to Aristotle: "Quemadmodum enim animae differunt, ita et natura ejus corporis differt." Van Helmont calls it "absolutely false and ignorant" to let any property of the soul take part in the body, although it might be linked up with the body (Phys. Arist. et Galeni ignara 4 ad Paragr. 3). Obviously van Helmont thinks of the vital importance which Aristotle attributed to heat (see before, note 15), but not to the actual unification of things corporeal and spiritual in the living being. Nevertheless van Helmont *has* expressed animistic concepts such as: "Clarum enim atque indubium est, quod homo nequeat se ipsum cognoscere, nisi prius animae cognitionem hauserit. Quippe sine anima est homo

commands bodily fluids and solid parts, it acts on them like a guardian on a child. This is particularly obvious in the functions which are today attributed to hormons. Van Helmont, however, emphasises hormonal and vegetative-nervous impulses in order to show that the genuinely vital functions cannot be explained by mechanical laws or the physiology of circulation. In van Helmont's system anatomical and particularly chemical changes in the living substance enjoy full attention. There is no special life-force which should be added to other forces in nature, there are only "seeds," and organised matter.

In many points, no doubt, van Helmont's doctrines of Life are related to the fundamental Aristotelian concepts of Eidos and Entelecheia. Like these van Helmont's Archeus is an active agent (*ποιοῦν*), inherent in the generating cause (*αἰτία*). It is often hard to see why van Helmont should attack these concepts. What van Helmont rejects is not infrequently the scholastic interpretation and mediaeval petrification of Aristotelian doctrines,[74] with the extensive use of formal logic and mathematical patterns which had largely replaced the knowledge of facts. No doubt, matter, elements, humours and humoral mixtures and above all warmth played the central role in the genuine Aristotle as well as the lore of the Schoolmen. Moreover, certain differences can be found between the Aristotelian Entelecheia and the Archeus. The former is not linked up with the free action of a living Creator. Entelecheia is more a philosophical and ontological entity than a real force in Nature seen in development and function. Van Helmont was bound to object, just as much on religious as on biological grounds. He went even so far as to connect the divine spark of Life with an "Odour," i. e. a substance of finest corporeality. Aristotle's concept would strictly exclude anything in the nature of a corporeal entity.

merum velut cadaver. "Tract. de Anima 3. Further passages from van Helmont see Pagel, Helmont, Leibniz, Stahl, 1931, *loc. cit.* p. 26, footnote and p. 45 footnote 2.

[74] See Weiss, Helene, Notes on the Greek concepts referred to in van Helmont *De Tempore. Osiris.* In Press. Here, the actual metaphysical and not only formal logical character of the Aristotelian concept of time is pointed out.

(5) *Van Helmont and Monadology*

(a) *The Principle of Life, Immanence, Quality.—Realism.*

Leibniz' " Monadologie " offers some aspects which show a striking parallelism with van Helmont 's system. It is surprising that this has not so far received attention. The reason seems to be that Leibniz rejected, expressis verbis, the "Archei " as far as they were supposed to act on the body as separate entity, altering the natural course of its mechanical and chemical processes.[75] Leibniz particularly objected to Stahl's "Animism." [76] This denied the existence or importance of any material processes or phenomena immanent to the body. As we have seen, van Helmont's concept differs widely from Stahl's Animism. Its object was to demonstrate and represent the " Energetic nature of Substance " (Glisson), the dynamical principles *immanent in matter* as opposed to those which might act on matter from outside such as Stahl's Anima. These immanent impulses exist of necessity in " organised matter." They are inherent in its smallest particles and therefore inseparable from it. Together with matter they form the individual being, and both represent two aspects of the same thing. Matter in this way is not subordinated to the soul but is the active vector of specificity. In van Helmont's concept a vindication of matter and its own sphere of action is achieved by its spiritualisation. This leads up to the scientific investigation of volatile substances, to substitution of the unreal elements and humours of the ancients by chemical entities such as Gas and to expression of vital reactions in chemical terms— in short to the search for real causes.

All this is congenial to Leibniz' Philosophy. Not abstract geo-

[75] G. G. Leibnitii Epistolae de rebus philosophicis ab anno 1699 ad me datae, in Frider. Hoffmanni, *Opera Omnia.* Genevae, 1754. Suppl. I, p. 55: Neque enim credo aliquid eum (Thomasius) in animo habere simile spiritui hylarchico Henrici Mori, qui et ipse doctrinam nunc communem impugnabat. Ego puto omnia phenomena naturae explicabilia esse mechanice, si quis caussas intelligat: etsi agnoscam, ipsa principia legum motus altiora esse, neque ex solis mathematicis considerationibus posse deduci: cum interveniat quiddam ἀπὸ τοῦ αγαθοῦ sive a caussa finali." (Sept. 23rd 1701.) See also Erdmann, Leibnit. Opera, 694 b; 702 a; 777 b.

[76] See the account of the controversy between Leibniz and Stahl in Pagel, W., *Arch. Gesch. d. Med.,* 1931, *loc. cit.* (Helmont, Leibniz, Stahl), p. 45 ff.

metrical synthesis of concept after concept and axiom after axiom is his method, but the organic development of observed facts out of a concrete principle, that of "Life."[77] Our mind, says Leibniz, undoubtedly contains in itself the germ of all truth. But experience is necessary to develop this germ. Otherwise mathematical deduction will never give us more than the "Possible" and not the "Real."[78] Mathematical patterns and rational thinking base their explanations on mere repetition of certain principles. Such repetition is an act of our mind. Reality, however, has to deal with the things as they are themselves, and no such repetition occurs here where everything is different in quality.[79] One may compare with this our quotations from van Helmont's writings on "Logica inutilis" and "Ratio."[80] Hence the "realistic" character of Leibniz' system. Its basis is the general idea of "Life," i. e. the specific differences of organic beings in form and function. There is no homogeneous reality in which the individuals are only modifications of an identical general medium or of a unique force and hence accessible to mechanical explanation. Each individual has its own force, developed and derived from its own "seed." The world consists of invisible Semina which, by the microscopical discoveries at Leibniz' time had become reality. As we have seen, the study of the "Semina" was van Helmont's chief concern. To find the general in the individual, i. e. in qualitative differences and in specificity was the idea of Leibniz' early work.[81] General phenomena and their quantitative graduation, such as modifications of motion and extension cannot determine an individual or a concrete object. Motion for example requires time in which it takes place. It could not explain anything if this is seen without time relation, e. g. in the smallest possible moment of time.[82] "Il faut," says Leibniz, "que les Monades aient quelques qualités, autrement se ne seraient pas même des êtres."[83] The same idea is expressed

[77] Compare A. Helfferich, *Spinoza und Leibniz oder das Wesen des Idealismus und des Realismus.* Hamburg und Gotha, 1846, p. 61.

[78] G. G. Leibnitii, *Opera Philos.* Edid. J. E. Erdmann, Berol. 1840, 171; 723 b. *La Monadologie* edid. E. Boutroux. Paris, p. 29/30.

[79] Erdmann 705 b.

[80] See before footnotes 5 ff.

[81] *Disputatio metaphys. de principio individui.* Lips. 1663.

[82] *Vernunftprincipien der Natur und Gnade,* her. Buchenau and Cassirer. Leipzig. Meiner., Vol. II, p. 436, footnote 482.

[83] Monadologie 8, ed. Boutroux, p. 144.

in van Helmont's polemic against the definition of natural objects as those which have the principle of motion and rest in themselves. Van Helmont says: by necessity an object must be before it moves, is moved or rests. The principle of Being precedes the initiation of movement or rest.[84]

Moreover, in van Helmont's opinion, this definition is directed against Creation. What, he asks, if God, after creation had added neither motion nor rest? Then, according to the above definition, creatures would have existed, but nature not:[85] Creation, however, is emphasised by Leibniz too. According to him, the monades show so intimate a connection of body and dynamic principle that they must have come into existence "tout d'un coup," i. e. by creation.[86] The firm belief in creation had prompted van Helmont's fight against the ancient materialistic theories: that corruption of one makes possible the generation of the other, that generation is simply a different arrangement of matter and due to accidental action of heat or to action of matter at all. Creation is the main point in which van Helmont disagrees with Aristotle's concept of Entelecheia.[87] To van Helmont creation means coming into being of seeds, in other words disposition of matter. Creation is also to van Helmont the unique act by which matter is endowed with form at once, the "tout d'un coup" of Leibniz.

(b) *Vita media. Magnum Oportet. Perceptions.*

To the Monadologie there is no birth nor death, but only *dev*elopment of the seed and its *env*elopment and regression to smallest germs.[88] Van Helmont said: "Generation means nothing but

[84] "Necesse est ut aliquid prius sit antequam moveat, moveatur aut quiescat. Principium essendi praecedit initium movendi aut quiescendi." Phys. Arist. et Galeni ignara 2/3.

[85] Phys. Arist. et Galeni ignara 2.

[86] Monadologie 6, Boutroux, p. 143.

[87] Pagel, W., *J. B. van Helmont.* Berlin, 1930, p. 29.

[88] Monadologie 73, Boutroux, p. 61. In the same sense Leibniz' answer to Fred. Hoffmann who says in a letter to Leibniz: "Credidi semper nullum corpus, quatenus vi praeditum est movente et mobili, interire posse, et interitum corporis nihil aliud esse, quam tantum ejus mutationem in mixtione, constructione et motu, et sic animal ceu individuum sive certum corpus perire, ut corpus autem sive substantiam permanere, ipsas mentes vero in individuo subsistere." Hoffmann wants to know

the flow of the seed towards perfection, the maturation of properties, the emergence of hidden qualities, the consummation of schedule down to its end." [89] Accordingly the " Vita media " of things played a particular role in his system. As a rule natural objects do not perish but persist in a reduced form. The object does not return to a completely imperceptible stage, its " Vita prima," such as exists in the seeds,[90] but to a fluid form not unlike embryonic matter or the fluid precursor of metals and stones. When we take in animal or plant substance as food, their specificity persists in us with their " middle life," their " odour and sapour." [91] Meat or pigs fed on fish definitely tastes of the latter, yet it is genuine pork. The persistence of the middle life of things entering our body accounts for its gradual changes. This is the " great necessity in this valley of misery," the " Magnum Oportet " of van Helmont. It dates from the original sin when the human archeus lost the power of completely absorbing and transforming food and " properties of middle life." At this time " duality, alterities and vicissitude " crept into human life. Now, we suffer from the " tyrannis and multiplicity of tribulations and spines " inflicted by " alien ferments," i. e. from what is specific in objects outside ourselves. They act on the archeus, combine with it and thereby initiate new generations which often turn out harmful to our life and functions. The Archeus governs the metabolism of the body; as "Archeus influus " the general metabolism of the organism as a whole, as " Archei insiti " the local dissimilation and assimilation in the organs and tissues. These Archei are responsible for the gradual absorption of food material and its conversion into organ substance. An " alien ferment " might elicit in these Archei an " appetite, aversion or neutrality," i. e. seduce them from the obedience to schedule and enchant them with illusions. Consequently they cannot do their duty, the foreign material taken

whether this meets with Leibniz' approval. (Epist. Leibnit., *loc. cit.* p. 51. Halae, 1699). Leibniz replied (Hannover, 1700): " Arbitror ego, omnem substantiam, quae una vere est, seu monas et individuum esse et permanentem: massam autem corpoream non esse substantiam sed substantias, ut grex vel exercitus." See also Leibniz' letter to Hoffmann, Sept. 27th 1699, *loc. cit.* p. 50.

[89] Ignotus hospes morbus 38.

[90] Magnum Oportet 28; 40.

[91] Magnum Oportet 25.

in with the food or with the breath is not properly incorporated and residues will remain not unlike tartar in wine-vats. These are the anatomical changes which we see in the organs in diseases. The concept of the preservation of the "middle life" thus explains and emphasises the *gradual* course of changes in the individual being.

In Leibniz' philosophy the *gradual* changes of the monades are of equal importance. The multiplicity of things in nature, i. e. the other monades are represented in the individual monade by "small perceptions."[92] These are open neither to mechanical explanation nor to geometrical description. The varying clearness of perceptions accounts for the difference between the individual monades and their gradual changes.[93] The preceptions range from small unconscious and dim impressions to high mental faculties such as sensitivity, memory, imagination. A similar series of "impressions" which account for specific differences between objects and their specific action is found in van Helmont's concept of "Magic" in Nature. Not unlike the small perceptions the "impressions" are linked up in van Helmont's philosophy with the representation in the individual, of the variety in nature. All action and all properties of natural beings are caused by their imagination of their own forms. This is the "sensus rerum" which accounts for effects such as ascribed to "sympathy and antipathy." The imagination of forms is simple, "corporeal and ignoble" in objects such as constituents of matter (viz. Sal, Sulfur and Mercury). To this category of forms belong the so called "occult qualities" of substances such as sleeping draughts or laxatives. Like the "small perceptions" they do not lend themselves to empirical analysis and had been wrongly denied by the Cartesian philosophers. Higher faculties originate in the imagination of forms of composed bodies such as the magnetism of the magnet, the virtue of tinctures, meat, roots, leaves, fruit. These virtues are specific, e. g. for the leaves of the rose, but not for its blossom and cannot be derived from their simple material constituents. Still higher in order is the virtue by which an entity is produced and transmitted to the suitable object ("Sympathy"). This is the real magic effect by which every agent acts on *its proper object.* The

[92] "Perceptio nihil aliud est quam multorum in uno expressio" (Erdmann 438).
[93] *Vernunftprinzip. d. Natur u. Gnade, loc. cit.* 2; Monadologie 17, Boutroux 149.

correct result of the action is due to a " presentiment " of that towards which the agent deliberately " sprays out " its activity. This occurs " after *sensing* the object, exciting phantasy, dispersing an ideal entity and copulating it with the ray of the passive entity." [94] Thus acts the magic virtue of animals such as the basilisk, the mad dog, special fishes, a virtue often inherent in the blood of these animals. The highest virtue, however, is not bound up with corporeal forces and effects, but due to the excitation of the power of the internal soul by the Holy Spirit or by intense imagination or speculation. It is productive of " the most potent procreations, the most august impressions and strongest effects." [95] The same principle of grades and stages of perceptive representation is applied in the Monadologie: the coarser, the more material and " hylic " the monade, the less clear and conscious the representation of the other monades, the perception. The difference between monades lies (just as in van Helmont's concept of " Magic ") in the degree of clearness with which they represent the outer world. There are as many degrees of representation and perception as monades.

(c) *The Organs, the "Archei," the Soul.*

Together with the matter belonging to it, each monade forms a living being. The rank of the perceptions of which it is capable, depends upon the development of the organs. A similar high importance van Helmont has attributed to the organs. We have mentioned the part they play in van Helmont's physiology of metabolism and shall discuss their significance as the " seat " of diseases later. The high estimation of the organs led van Helmont to foreshadow the idea of specific sensual energy. This is the result of specific organ function. It is the same vital impulse (" Spirit ") which is carried with the blood to *all* organs, but is adapted by the action of the latter to the particular local function without undergoing substantial changes. The " spirit " conveyed to the tongue accounts for the perception of taste, but it will cause no such thing in the finger. There will be as many essential modifications of the spirit as there are organ-functions.[96]

[94] De magnetica vulnerum curatione 152.
[95] *Ibid.* 157.
[96] Spiritus Vitae 29.

The monade in animals is the soul. This is subject to changes which occur pari passu with the metamorphoses of the body. But never will the soul leave this and enter other bodies, in other words there is no such thing as "metempsychosis." Body and soul form an indissoluble unity. This was emphasised both by Johann Baptista and his son Francis Mercur van Helmont, the friend of Leibniz.[97] The whole object of van Helmont's complicated representation of the Semen containing Forms and Archei was to demonstrate the close union of body and soul. This is in remarkable contrast with the later systems, notably those of Stahl and Hoffmann. The latter degraded the Archei to a purely physical "Ether" and nervous fluid. He did not pay much attention to the soul. The material substratum of the body is active in itself, it exhibits motion, secretion and excretion. The principle of Life ("Vitae ratio") should be searched for in the purely mechanical action of the body, not in its conjunction with the soul which is of general philosophical rather than of medical interest.[98] Stahl, on the other hand, understood motion as an immaterial substance and action of the soul, migrating into the body from outside. Bodies were parts of the purely passive matter which

[97] Pagel, W., *Arch. Gesch. d. Mediz.*, 1931, XXIV, 29.

[98] Hoffmann recognises the immanent dynamic impulses in the body and objects to the Cartesian concept of its passivity, a concept which shows the origin of Stahl's Animism: Descartes' philosophy. Leibniz had attacked Sturm who, with Descartes, ruled: "Corpora esse materiam, quae mere se habeat passive, omni vi movente destitutam, hanc vero immediate a Deo ipsi communicari, adeo, ut ipse infinita sua virtute materiam ubique actuet, moveat et per ipsam in universo operetur." Hoffmann supports Leibniz' point of view. According to him a mere passive ens cannot exist in reality and is not more than an abstract product of our mind. It is also impossible that a passive ens should be able to receive or retain any impulse coming to it from an outside source, viz. the Anima, or direct divine impulses. "Universalis Dei impulsus non ipse agit omnia, sed ipse excitat corpora, ut juxta vires suas a Deo ubivis extenso impenetrabili concessas agant: inducit rebus non motum ipsum, sed necessitatem immutabilitatis ad motum, cuius motus principium tamen ipsis rebus non est mere externum, sed internum." (Epist. Leibnitianae, *loc. cit.* p. 50.) The action of spirits and souls is free, independent and therefore irregular, that of the body "ex necessitate harmonice" and therefore uniform and regular.—Leibniz, in a letter to Hoffmann (Hannover, Sept. 27th, 1699) agrees that passive entia are never found alone nor can they exist by themselves.

As to Hoffmann's doctrine and its difference from that of Stahl see: Hoffmann, De differentia Doctrinae Stahlianae et Hoffmannianae, *Opera Omnia, loc. cit.* Suppl. I, p. 438 ff. and passim.

had constantly to be preserved from decay.[99] Both Stahl's and Hoffmann's views are dualistic, and remote from van Helmont's and Leibniz' natural philosophies.

The monade acts out of itself and from its own initiative, it has "Autarkeia" and "no windows" through which anything could enter into it from the outside.[100] Similarly van Helmont's Archeus acts by its own spontaneity, according to its innate schedule which runs down to its destined end. Nature is thus "ignorant of Contraria." Nothing can fundamentally alter the Archeus.[101] It might be disturbed, however, by illusions and "appetites" which "alien ferments" elicit in the individual. These will have no influence on the being unless directed by its own archeus. In the same way, natural changes in Leibniz' monades "viennent d'un principe interne, puisqu'une cause externe ne saurait influer dans son intérieur." [102]

True to cabbalistic and neo-platonic tradition van Helmont regards the "Form" of Life which divine creation bestows on the individual being as a light or spark. Leibniz speaks of: "Fulgurations continuelles de la divinité," which give birth to the monades.[103] It is divine perfection, the "essence" which is thus conferred, but limited by the receptivity, the empirical "existence" of the creature.[104] In a similar way van Helmont pointed to the original sin as the source of all the shortcomings of creatures.

[99] We have quoted before (footnote 73) passages from van Helmont which show an anticipation of some concepts of Stahl. The latter fights like van Helmont against humoral-pathology. Not the humours themselves, not "Dyscrasia," but anomalies in their motion and circulation are the cause of disease. This is a "Perturbata idea regiminis ipsius oeconomiae animalis," terms which are, no doubt, adopted from van Helmont and his "Idea Morbosa." (see *Theoria Medica Vera*, ed. L. Choulant, Lipsiae, 1831, Vol. II, p. 16). The structure and mixture of the bodily constituents are of no significance, since the body is subject to corruption at any time in the same measure. Moreover, according to old Hippocratic wisdom just the most vigorous bodies (athletes) and the best and "floridissimus" blood are most liable to corruption which may take place within a few hours because of the heat which is preserved in the lifeless body (*loc. cit.* p. 25). Fever is a healing process which does not occur "in malignis et contagiosis." In these "Urina sana, pulsus sanus, aeger moritur." (*ib.* p. 34). Fever is directly controlled by the "Animi Pathemata." In the same way inflammation is a healing process (p. 42).

[100] Monadologie 7, Boutroux 144.

[101] Van Helmont's treatise: Natura Contrariorum Nescia.

[103] Monadologie 11, Boutroux p. 146.

[103] Monadol. 47, B. p. 167.

[104] Monadol. 42, B. p. 162.

(d) *Divergencies*

Some points may be mentioned in which van Helmont's concept differs from Leibniz' Philosophy. They are of minor significance. Leibniz adhered to the theory of "Preformation." Everything pre-exists in the germ in a minute compass. Development means growing of these minute elements into visible organs. Van Helmont, however, may be said to have advocated the "epigenetic" point of view. He compares the Archeus with a blacksmith who actually "perambulates through all recessus of the semen and starts to transform matter according to the entelecheia of his image. Here he locates the heart, there the brain, and everywhere appoints the resident governor for the realms determined by their exigencies, parts, destinations." [105] There is obviously no material preformation, but only a "preformation of tendency" in van Helmont's view.

The perceptions and impressions which van Helmont attributed to living beings are mainly those of their own specific forms and of "alien ferments" rather than a representation of all the other monades and indeed of the whole universe which Leibniz saw in the individual monade. It should be borne in mind, however, that van Helmont subscribed to Determinism. There is "Reason and an immutable root producing certain appointed effects." In the Universe and the Semina, Ferments and Archei are the instruments of this determination as they contain "Type, Form, Motion, Hour, Vicissitudes, Tendencies, Properties, Adaptations, Relations, Changes, Death" of everything in Nature.[106]

In Leibniz' concept the whole of the world space is filled up. Therefore, every motion in it must, of necessity, influence the whole and all of its parts. Thus, Determinism accounts for the representation of the Universe in the individual monade.[107]

Leibniz clearly separated his metaphysical principles from the explanation of individual natural phenomena which, according to him, have to be given on strict physico-chemical lines. Van Helmont, however, may not have accomplished or not even attempted such

[105] Archeus Faber 6/7.
[106] Causae et Initia Natural. 24 ff.
[107] Monadol. 61.

critical separation. In his " Philosophy " scientific and metaphysical elements are mixed up.

The views which van Helmont has in common with Leibniz are obviously those which are based on his religious conviction. This may throw a particular religious light on the origin of Leibniz' Philosophy.

(6) *Central Regulation*

As we have seen, van Helmont's basic principle in *Physiology* was vitalism prompted by religious conviction. Religious motives are recognisable even in his work on individual physiological problems. Research on the stomach and its functions is of the utmost importance to van Helmont because he has found by casual observation and theoretical consideration that here must be the seat of the chief vegetative impulses and indeed of the soul, i. e. of the divine principle governing the body. Sad news takes the appetite away, fever impairs digestion in the stomach and elicits ructus indicating some putrefaction in the stomach.[108] Nightmares are caused by rich food, they make the person unable to move without impairing their sensual perception. This shows the essential role of the stomach in motion.[109] Syncope from carbon-monoxide poisoning causes, as van Helmont experienced once himself, a sensation around the mouth of the stomach.[110] All this demonstrates the action of the stomach on the brain. This action does not lend itself to a materialistic explanation by means of vapours and fumes which were supposed to emanate from the stomach. Even with an empty stomach certain remedies (e. g. Sulfur vitrioli) acting on this organ will relieve syncope. Thus, there is no place for vapours ascending from corrupting food left in the stomach. Neither do such ascending vapours exist, nor can vapours be condensed in the brain to fluid and flow down again thereby causing the multitude of the famous " Catarrh "-diseases.[111] Disturbances of the stomach like colic and stomach ache might be followed by paralysis of the limbs or by tetanus.[112] A huge hernia

[108] Jus Duumviratus 13.
[109] Jus Duumvir. 15.
[110] Jus Duumvir. 19.
[111] Catarrhi Deliramenta passim. See translation and commentary in Pagel, W., J. B. van Helmont, 1930, *loc. cit.*
[112] Jus Duumvir. 20.

beating all attempts at reposition in spite of continuous hot fomentation became soft and amenable to reposition at once when the stomach had been treated by a wine decoction with various seeds (Coriander, Anise, Caraway, Fennel).[113] Even the intellectual faculties are largely governed by the "Duumvirate," i. e. the combined action of spleen and stomach. A man who had taken Hyoscyamus in error remained "innocens et vesanus" although the drug had been removed from the stomach by means of a vomitive. There was therefore no question of fumes ascending from remnants of the drug in the stomach to the brain. Insanity in this case was in van Helmont's opinion entirely due to the action of the stomach injured by the poison.[114] Amentia makes a man insensitive to hunger and thirst.[115] Helleborus so beneficial in mental affections is a classical vomitive, a "remedium stomachicum." Stomachica also help in cough and asthma of the old people, thereby revealing the importance of the stomach for the lung.[116] The impulse to sleep is initiated in the stomach and then carried to the brain.[117] Affections of the uterus such as Hysteria, abnormal appetites in pregnancy, Epilepsia and others are primarily elicited in the "duumvirate" of stomach and spleen. In other words: the stomach contains like a bed the Anima and hence come all vital powers.[118] The "Duumvirate" watches over the "Symmetry of Life" by means of "tender modulation."[119] The stomach is thus the central organ profoundly connected with the action of the Divine in man. Hence the duty to examine its anatomy and physiology with particular scientific care and attention. Led by these principles, van Helmont not only discovered acid as the principle of digestion in the stomach, but also, what is less well known, the particular rhythmic movement of the pylorus. The pyloric movement follows its own laws. It is different from that of other orifices such as bladder and anus, in nature and rhythm. Not unlike the uterus the Pylorus is its own Monarch endowed with total power and governed by its own "Blas," i. e. an impulse to motion and alteration such as emanating from the stars.[120] It initiates vomit-

[113] Jus Duumviratus 20.
[114] Jus Duumvir. 22.
[115] Jus Duumvir. 24.
[116] Jus Duumvir. 62.
[117] Jus Duumvir. 54.
[118] Jus Duumvir. 58.
[119] Jus Duumvir. 52.
[120] Pylorus Rector 4.

ing when it closes and sends a wave of motion over the whole organ towards the oesophagus. Hence it is by no means devoted to a retaining function or connected with Galen 's " retentive dynamis." It knows what it has to do by its own discretion, e. g. to open and relax when acid digestion has reached the end point. It thereby regulates acid digestion, it " keeps the key " to the stomach. If it remains closed too long, the over-digested food is liable to cause corruption, " alienation " and disease. If it opens too early, insufficiently digested food will cause disturbances chiefly in the veins: Tremor, palpitation, fainting, acute fevers, tumours, arthritis may thus develop. As soon as new food enters the stomach the Pylorus closes again. If some of the old food is left in the stomach, its over-digestion will upset metabolism. Hence hyperacidity results from ravenous eating. If the pylorus fails to open and causes vomiting this is because it finds (" censet ") that it would be harmful for the whole body to let this particular food through. The pylorus is thus the " Rector digestionis." [121] It cooperates in concurrence with the bile, and diarrhoea, dysentery, haemorrhoids and various other intestinal trouble develop when this " consensus " of pylorus and bile is at fault. The pylorus is subject to emotions such as fury, for example when a limb has suffered severe injury, vomiting may follow as expression of the fury of the pylorus. This will be instantly relieved when the limb is put right. Poisoning may lead to general paralysis, due to the " indignation " felt by the pylorus. Pyloric spasm may cause exudation of greenish fluid into the stomach and eventually death. Postmortem examination shows in such cases the closed or strictured pylorus—in contrast with other muscular spasms which disappear after death.[122]

The minute and advanced observation of the stomach in normal and pathological life thus offers another example of the immediate scientific significance of van Helmont's yearning to find the seat of the vegetative and life centre, which meant to him the Divine in man.

(7) *The Origin of Diseases*

The larger part of van Helmont's work was devoted to *Pathology and Medicine.* Religious pragmatism drives him to Medicine as the

[121] Pylor. Rect. 11. [122] Pylor. Rector 29.

ultimate aim of science and he is conscious of his vocation as physician. What *is* Disease and what are its causes? This question fundamental to Pathology and Therapy had been left unanswered by contemporary Medicine which taught the "Artificiose altercari" but in practice was unable to cure headache or tooth-caries. If objects and phenomena in nature are entities by themselves, due to the development of a specific seed, diseases, van Helmont concludes, must be also such entities and due to a specific cause of their own, their specific seed. Pathology at van Helmont's time largely followed the ancient theory which regarded man himself, i. e. the mixture of his humours, his temperament as the chief cause of disease. This varies with the faulty humour, the humoral mixture, or the "quality" which, already in normal life predominated in the patient. To van Helmont, however, the disease-entity is something outside man, an "alien-ferment" which impresses its own schedule of Life on the Archeus of the Patient. It is thus an "Idea Morbosa" acting on our internal imagination, since all transmutations and indeed all action in nature are due to the imagination of a "Form," or as Leibniz would have expressed it, to the internal perceptions experienced by the "Monade." The "Alien Ferment" thus "contaminates" the Archeus, it acts as a "Contagium." Disease becomes identical with its external cause. Such causes are: the morbid impression conveyed with the bite of a mad dog, metallic and silica dust inhaled in mines, "Recepta" taken in with food or breath such as drink, Pharmaka, poisons, suggested ideas and above all the "Retenta," i. e. products of disturbance of one of the six "Digestions."[123] There must be as many diseases as causes. This ontological and aetiological concept of diseases paves the way (a) to their *classification* and (b) to *causal therapy*. Therapy of the Ancients was directed against the wrong humours and qualities, i. e. against man and his faulty constitution. It aimed at restoring the material balance of the body and thereby to cure diseases. In van Helmont's view therapy is directed

[123] Van Helmont differentiates six "digestions": (1) Acid digestion of food in the stomach; (2) its alkalinisation in the duodenum; (3) Digestion in the liver leading to production of venous blood (Cruor); (4) Conversion of Cruor into arterial blood in the heart; (5) Production of "Vital Spirit" in the brain; (6) Assimilation and conversion of suitable material into tissue substance in the organs and their "kitchens."

against the cause. After its removal the balance of the material constituents will recur automatically. The " contagious " cause had to be washed off from the archeus, to relieve it from the alien idea so that it might recover its genuine scope and schedule. Ancient therapy largely used dietetics, laxatives, venaesection and herbs—van Helmont's therapy is based on the powerful menstrua, the great " Confortativa et Restaurativa," the chemical remedies prescribed by Paracelsus, compounds of sulfur, antimony, mercury, metallic preparations. He by no means omitted purely empirical and " magic " prescriptions such as ram's testicle and blood against pleurisy and many other items of the " Dreckapotheke." " Magic " therapy in van Helmont's Medicine, however, is deeply bound up with the recommendation of immunological treatment which is far in advance of his own time and based on the knowledge of the beneficial effect of blood of convalescents.[124]

If disease is due to an alien ferment or idea coming from outside, it will combine with that part of the body to which it has a special sympathy or affinity. To open the way for the pathogenic agent into the body, it needs a propitious " imagination " on the part of the Archeus. There are as many archei, i. e. local governors ("Archei insiti ") as organs. Disease therefore is a *local,* an organ affair.

The ability to dissolve is one of the noblest effects which Nature achieves in mastering matter. The highest aspiration of the early chemist notably van Helmont was to invent a universal solvent, the Liquor Alkahest. The main function of the Archeus is to dissolve food material conveyed with the blood and to see that no crude residue is left. The Archeus thus acts as a " Custos," as the metabolic centre of the organ. Each organ has a " kitchen " [125]—the tooth at its root, the nail in its bed, the skin in its basal layers, the stomach in the spleen. Here the Archeus separates from the blood stream what is suitable for the particular organ and converts it into tissue

[124] De magnet. vulner. curat. 50: " Curatur autem tuto et celeriter, si sanguine cuiusdam, qui semel illo morbo laboraverit, foris vel tenuiter locus inungatur. Nempe qui semel a morbo illo convaluerit, sanguinem nedum balsamicum obtinuit, unde in posterius ab eodem morbo tutus sit."

Compare van Helmont's general and special Pathology and Therapy in Pagel, W., J. B. van Helmont, *loc. cit.* 1930, pp. 75, 77, 89 ff.

[125] Catarrhi Deliramenta 31.

substance. Disturbed in this function by the illusions emanating from an "alien ferment," the archeus will lack in its power to dissolve; it will fail in its watchman's duties. Residues will appear—the anatomical changes. Disease may be also provoked by the local Archeus eliciting abnormal acid in the cruor. For example, in the pleura the cruor turning acid causes spasms with subsequent tearing and ulceration of the pleural membrane. In addition the acid cruor coagulates and forms a deposit. This leads to local obstruction of pores and channels which should be free if normal function is to be maintained.

The local origin and development of diseases exclude the "Folly of Catarrh" and the action of "Vapours" which dominated Pathology for a long time after van Helmont's death.

Van Helmont thus became the actual founder of modern Pathology. It was he who taught the differentiation of diseases according to local changes (Morbid Anatomy) and external causes (Aetiology). His concept was in many points in advance of that of the famous "Father of Pathology" Morgagni who simply referred symptoms (not diseases) to anatomical organ changes. It is true that he thereby greatly furthered the art of clinical diagnosis.

I have endeavoured to show that the whole of van Helmont's Pathology down to his "Localism," Aetiology and new Therapy is based on his general philosophical and metaphysical view, on his concept of Semina and of disposed matter as the vector of specificity. Fundamental positions in Medicine thus grew out of his religious conviction, his belief in creation.

(8) *Biological Time and Theology*

Van Helmont's religious conviction of Nature as the embodiment of created specific seeds led him to an ingenious anticipation of the modern concept of Biological Time. He propounds this in a treatise (*De Tempore*) which has never had the attention which it actually deserves as an attempt at linking up Time with the specific life forces of the individual. I hope to give a translation and commentary of this treatise elsewhere,[126] but wish to summarise it briefly

[126] Pagel, W., Van Helmont, *De Tempore* and the History of the Biological Concept of Time. With notes on the Greek concepts referred to in *De Temp.* by Helene Weiss, *Osiris.* In Press. Summary in *Isis*, 1942, XXXIII, 621.

here, because nowhere in van Helmont's work does the close interdependence of religious belief, philosophical outlook and scientific achievement appear as striking as here.

Like all treatises by van Helmont it sets out with the somewhat weary and extensive refutation of the doctrine of the Schools which is based on Aristotle's Physics.[127] Aristotle had linked up time with motion, Time counts motion, he had said. In van Helmont's opinion, however, time is no less an entity than anything else in nature. Days, hours and seasons are measuring units, invented by the human mind. They are not Time. This cannot be defined by mathematical construction of a continuum of infinite points, by the length or shortness, by priority or posteriority of something nor anything which can be measured. Real time which should be called " Duration " is created by God and inherent in the seed of each object in Nature. It determines the specific life rhythm and life duration of the individual by governing its motions. " For all variety of whatever alterations depends upon the slowness or celerity of motions. The duration of motion is therefore essentially, intimately and originally immanent in the seeds as their form and directing principle." [128] It is the variety of biological processes by which time may be gauged. As the seeds of the living beings are created by God from eternal times, time is eternal and devoid of succession.[129] It represents the creator in the creatures, but is not only the sum total of this something in all creatures; it has an existence independent of and above the creatures, it is something " absolute " and divine.

These religious-metaphysical considerations lead van Helmont to a critical examination of time measuring as actually practised in his days. He realises the fallacies of clocks which are subject to temperature influence and recommends the use of the pendulum. He discovers the significance of the length of the pendulum for its velocity and states that the duration of the swings is equal, although he believes that their range is diminished gradually.[130]

[127] *De Tempore* 1-16 and 20-24.

[128] " Duratio . . . seminibus quippe universis ab initio inest, nedum principium cuiusvis motus, sed et sua durationum determinata periodus, cuique motui propria; cum omnis varietas quarumcumque alterationum pendeat ex tarditate vel celeritate motuum. Igitur motuum duratio includitur seminibus essentialiter, intime originaliterque velut principium formale atque directivum eorundem." *De Tempore* 18.

[129] *Ibidem* 30.

[130] *Ibidem* 48-50.

The usual Aristotelian and scholastic concept of Time, the undue attention devoted to the movement of the stars in connection with the study and measuring of time, has secured the dominating position of the doctrine of " Critical Days " in Medicine, ever since early Pythagorean days. The constellation of the celestial bodies and particularly the influence of the moon had been made responsible for disease to take a favorable or unfavorable turn. Galen said that crises on a sixth day are dangerous and difficult to obtain, but easy and propitious on the seventh day, the sixth being similar to a cruel tyrant and the seventh to a wise and just king.[131] Here again van Helmont sees the Schoolmen resort to the analogies of Macrocosm and Microcosm and thereby to crude mechanistic and monistic explanations. These were bound to rouse van Helmont's opposition which was prompted by his better vitalistic and pluralistic insight and conviction.[132]

Ancient Therapy was expectative. It welcomed crises as an indication of the " Healing Power of Nature," its attempts to drive out harmful humours. In van Helmont's opinion crises should be avoided and cure accomplished before crisis sets in. There are no humours against which nature should " fight," there is no place for " Contraria " in Nature, there is only the pathogenic agent which should be removed by active intervention of the physician. Not constellation of stars, not critical days, i. e. regularities which are supposed to govern *all* diseases, but the *specific* rhythms and " life-times " of the different disease-entities should the Physician study.

Linking up time with the Divine spark of Life in the individual, with the time of life and the quality of the biological processes, van Helmont uses arguments reminiscent of those propounded in modern times by Bergson[133] and biologists and sociologists who deny that

[131] De diebus decretoriis I, 4; ed. Kuehn, Vol. IX, p. 785; I, 2, p. 774; II, 2, p. 846; II, 8, p. 875; I, 5, p. 792. Compare detail in A. M. Baumgarten-Crusius, *Periodologie oder Lehre von den periodischen Veraenderungen im Leben des gesunden und kranken Menschen.* Halle, 1836, pp. 54 ff. and also p. 264.

[132] *De Tempore* 52.

[133] *Time and Free Will. Essays on the immediate data of consciousness.* Transl. by F. L. Pogson. London, 1910, p. 107. Measuring time in the usual sense is counting " simultaneities." It is the internal process of organisation of conscious states which is real duration and produces succession. Bergson's time is

Time has the purely quantitative character of "astronomical time." Indeed, the speed of biological processes varies, for example with the size of the animal or with its age. As Joseph Needham puts it: "Mouse time must bear the same or a similar relation to elephant time as mouse spatial magnitudes to elephant spatial magnitudes."[184] The calendar of primitive people differs in agricultural, hunting and pastoral groups (Sorokin and Merton).[185] Biological processes form a clock by themselves which gives more and truer information about Time than the ordinary—conventional—time units. These indicate "empty," quantitatively equal periods which are unequal biologically and sociologically.

Nothing shows the whole character and scope of van Helmont's work as impressively as *De Tempore*. All that van Helmont designs, finds and teaches, he does for the sake of research on Life, for Biology, in the widest sense. For he regards Life as direct emanation from the creating God and therefore not only the noblest but also the only subject which opens the way to scientific and at the same time to eternal truth. Van Helmont's biological bent is due to his religious zeal, and his scientific achievement the fruit of his religious conviction.

thus much more bound up with the conscious self than van Helmont's Time which is the rhythm of the biological processes specific for the individual, its predestined life-time. Moreover van Helmont's Time has a theological significance as it is identical with eternity, unmeasurable and devoid of succession. Nevertheless there are striking parallels, e. g. van Helmont's argument that categories of space are introduced when we try to measure time (*De Tempore* 31).

[184] For "Biological Time" compare: Joseph Needham, Chemical Heterogony and the ground plan of animal growth. *Biol. Review*, 1934, IX, 79. Lambert, R. and Teissier, S., *Ann. Physic. & Physiol. Chemistry*, 1927, II, 212. As to "Sociological Time" see: Sorokin, P. A. and Merton, R. K., footnote 135.

[185] Social Time. *Amer. J. Sociol.*, 1937, XLII, 615.